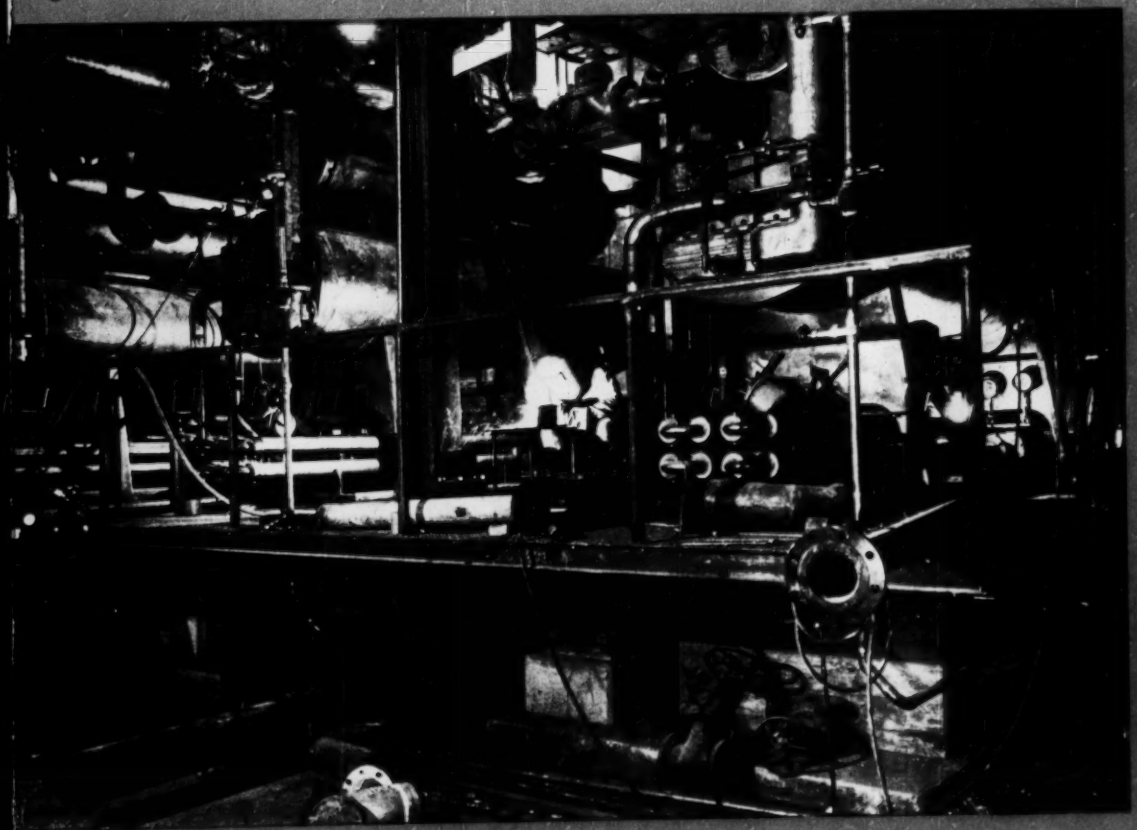
# Heating Piping & Air Conditioning

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

MAY ★ 1950

INDUSTRIAL
COMMERCIAL
INSTITUTIONAL AND
PUBLIC BUILDINGS

*Page 113—Journal Section of the American Society of Heating and Ventilating Engineers*



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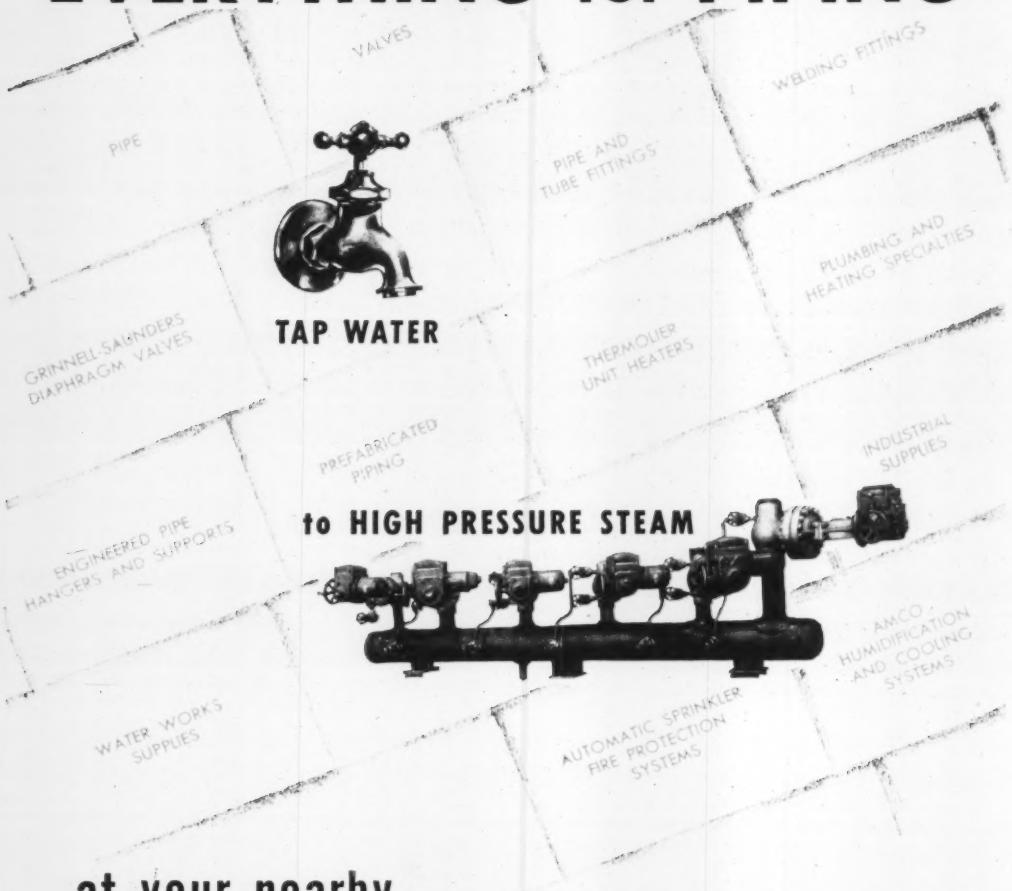
# EVERYTHING for PIPING

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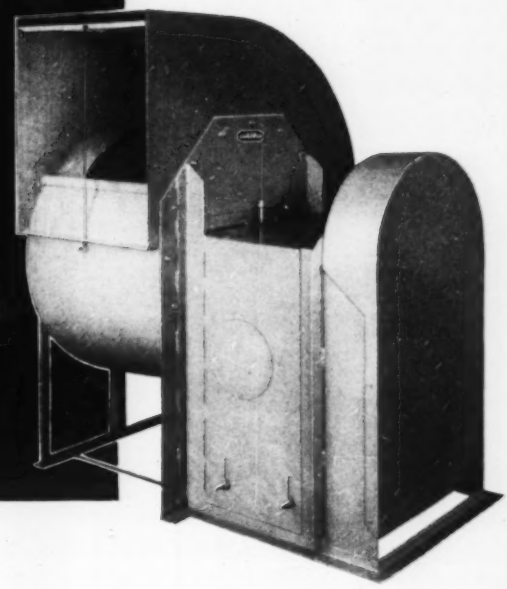

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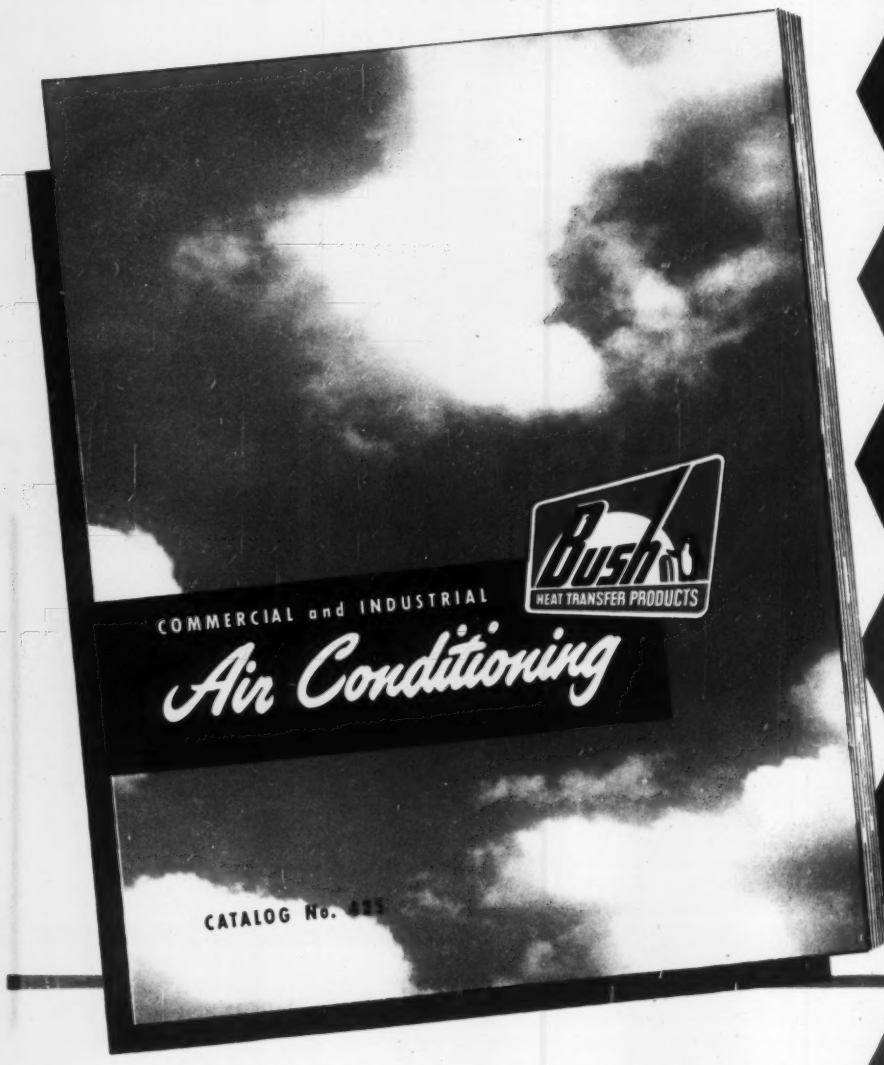


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# Heating Piping & Air Conditioning

(with which is merged the Aerologist)

DESIGN, INSTALLATION, OPERATION, AND MAINTENANCE IN INDUSTRIAL, COMMERCIAL, INSTITUTIONAL, AND PUBLIC BUILDINGS

MAY 1950 . . . Vol. 22, No. 5



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Published monthly by the Keeney Publishing Co., 6 N. Michigan Ave., Chicago 2, Ill. Telephone: STate 2-6916. Subscriptions: U.S. and possessions, $3.00 per year; Canada, Cuba, Mexico, Central America, South America, $4.00 per year; other, $6.00. Current copies, U.S. and possessions, 35c each; back copies, 60c each. January 1950 issue, $1.50 per copy. For change of address, notify publisher and your local post office of both old and new addresses by the 15th of the preceding month. Member Audit Bureau of Circulations and Associated Business Publications, Inc. Heating, Piping & Air Conditioning is indexed regularly by Engineering Index, Inc.


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Entered as Second Class Matter May 18, 1929, at the Post Office at Chicago, Ill., U.S.A., under the Act of March 3, 1879. Additional entry at Milwaukee, Wis.



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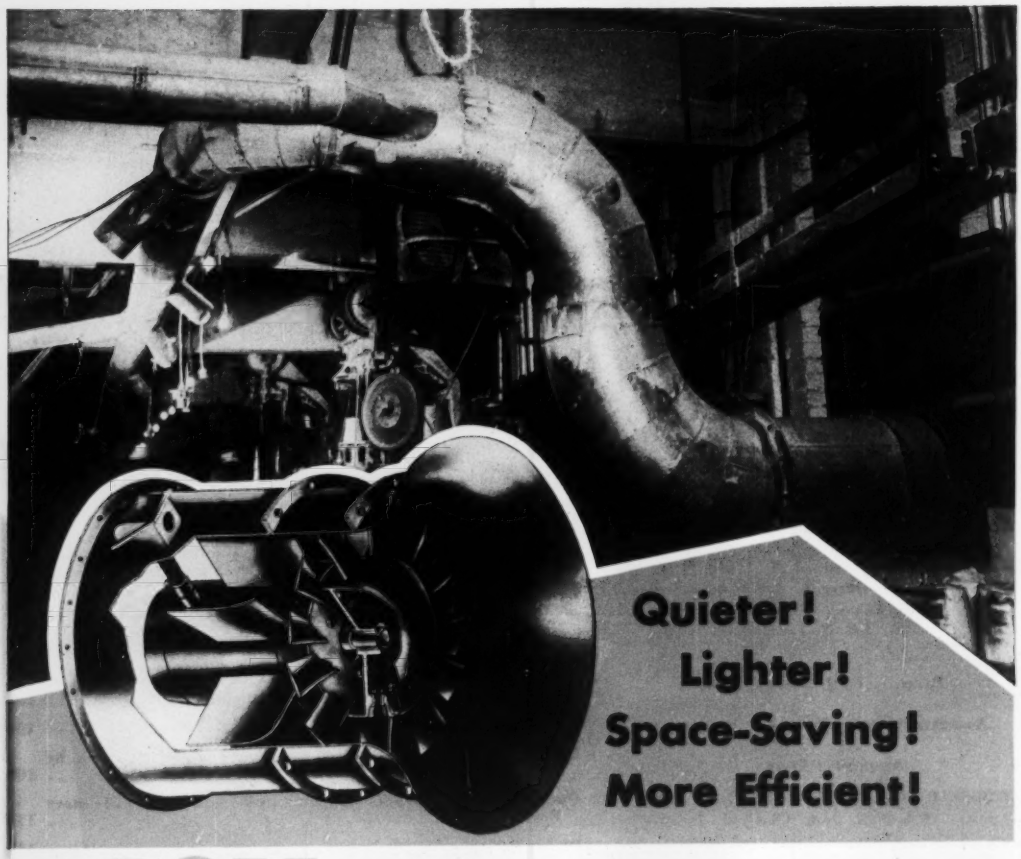


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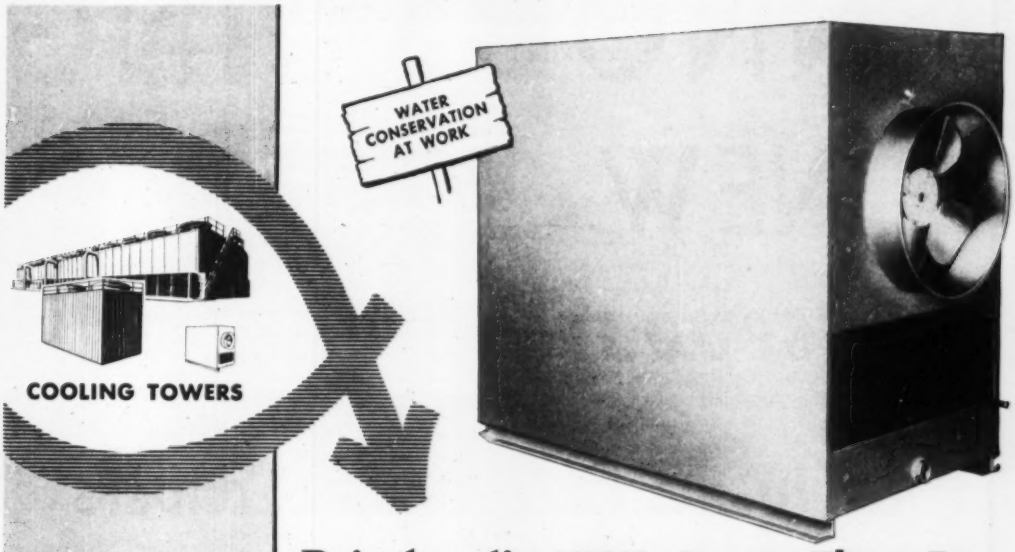


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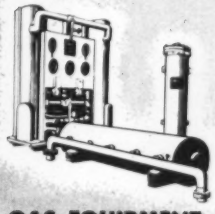
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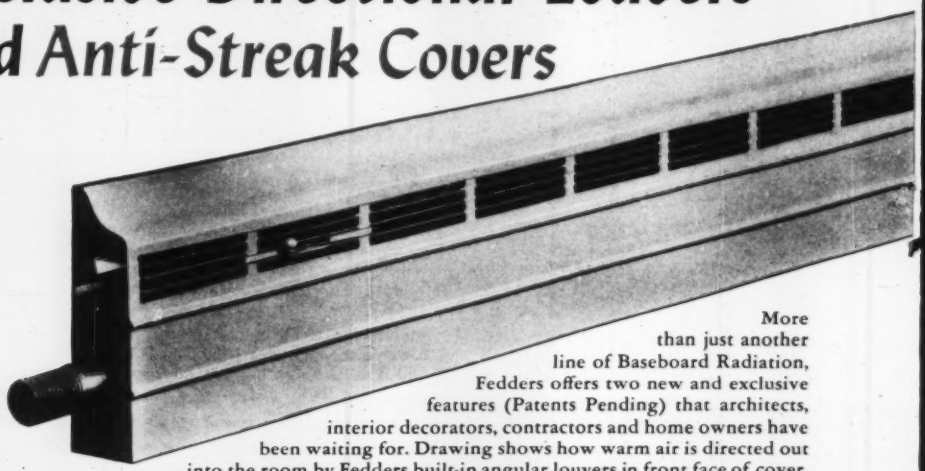
## Exclusive Directional Louvers and Anti-Streak Covers



More than just another line of Baseboard Radiation, Fedders offers two new and exclusive features (Patents Pending) that architects, interior decorators, contractors and home owners have been waiting for. Drawing shows how warm air is directed out into the room by Fedders built-in angular louvers in front face of cover. Also see how cool air flows down from the wall and is directed out into the warm air stream by means of specially designed curved top of cover. These features greatly reduce streaking of walls and contribute to uniformity of temperature from floor to ceiling.

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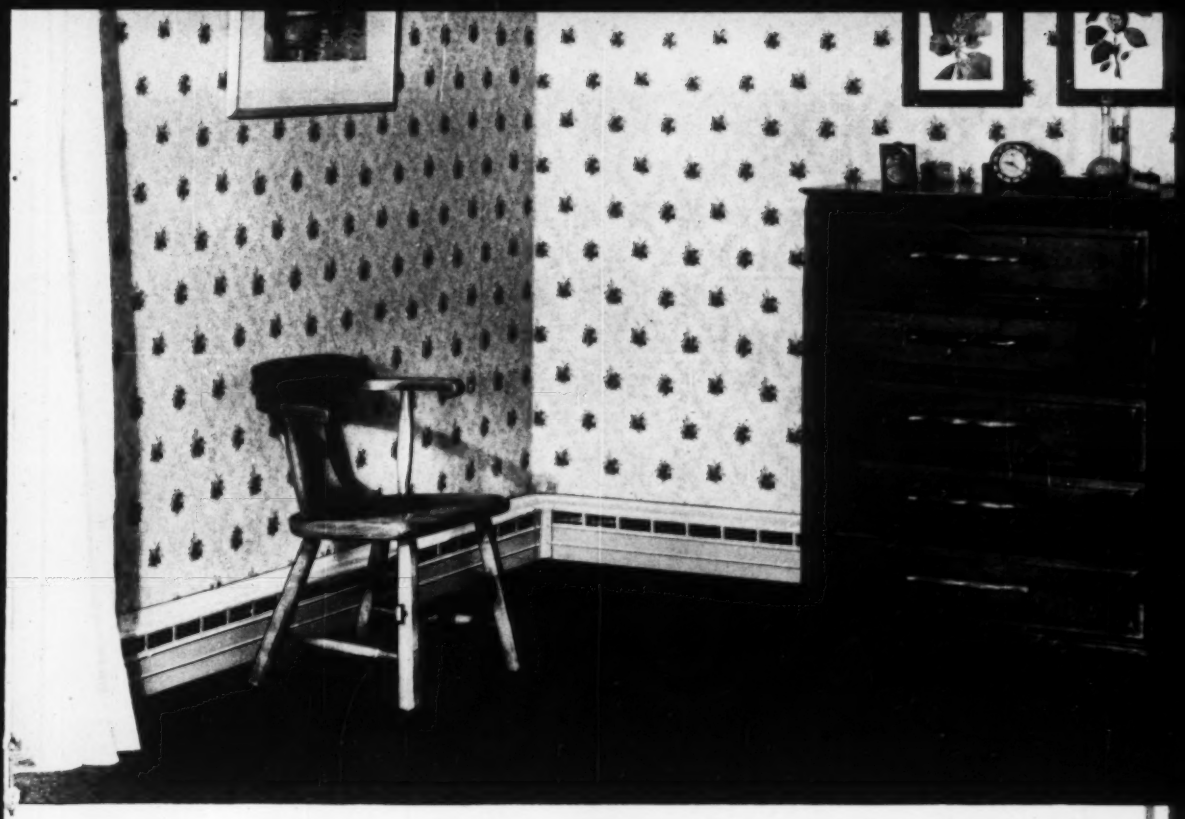
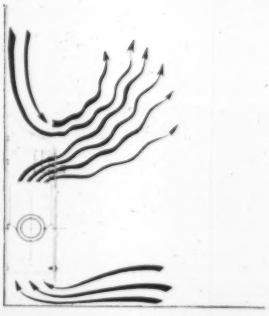
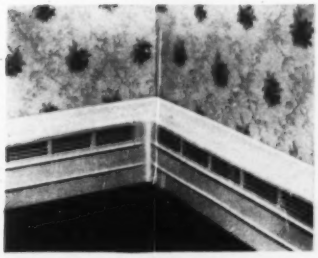


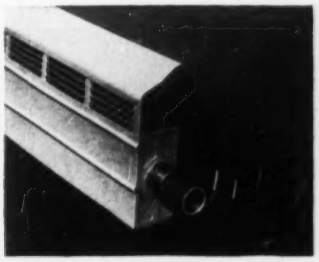
● Showing compact installation of Fedders Baseboard Radiation occupying little more space than ordinary wood baseboards.



Cross-section shows how air is directed out away from walls by means of exclusive directional louvers and curved, anti-streak covers.



Neat installation for inside and outside corners provided by Fedders overlapping corner pieces.



Showing position of Fedders high efficiency heating finned element within the cover.

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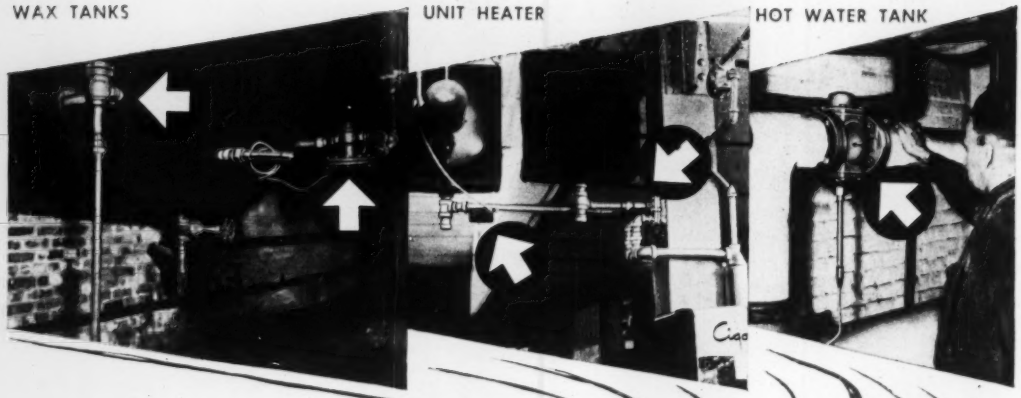


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"I've been paying for Sarco Steam Traps and temperature controls for years in wasted heat. Thought I might as well have them and the other advantages too."

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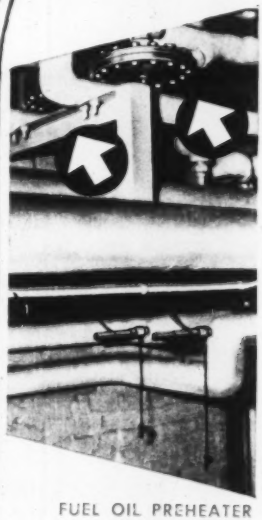

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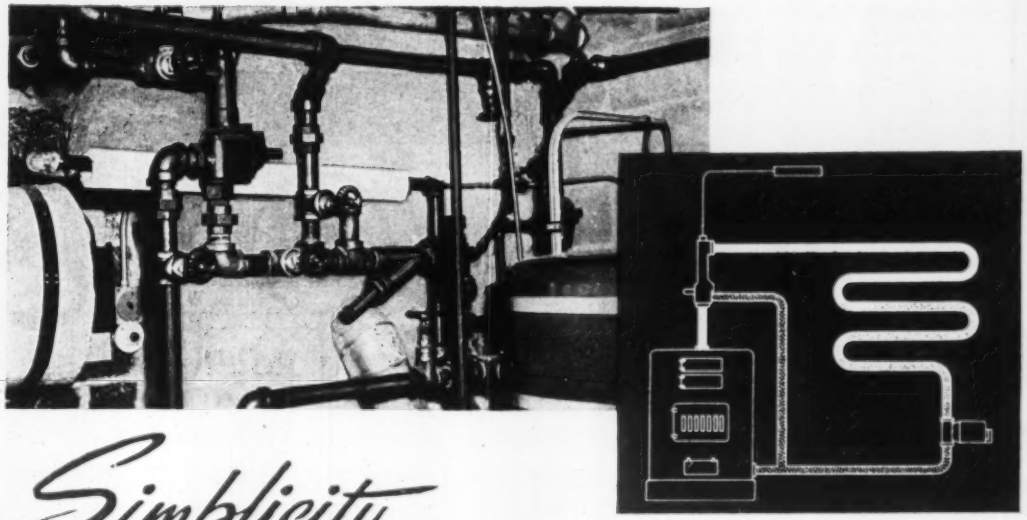

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Sarcotherm has made great strides in the past five years, thanks largely to architects and heating men who have appreciated its simplicity, flexibility and low cost. The designer can figure on lower boiler temperatures, even comfort for all outside conditions, zone control, split systems, night set-back—all with the same simple three way valve that comes in a package called "Sarcotherm."

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And finally, because each Sarcotherm job leads to others, the volume of business grows, and since servicing costs of this simple, reliable system are low, the profits go up.

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# Sarcotherm

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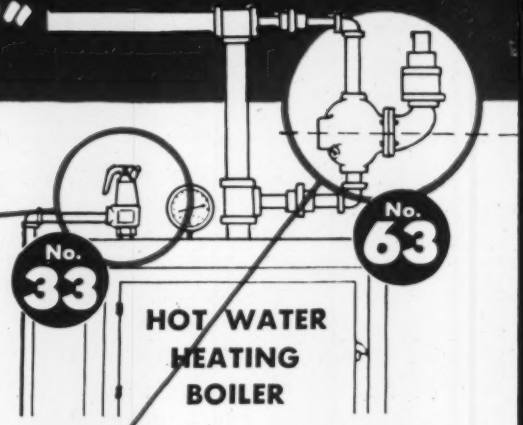
15

# "Where have you been keeping this combination?"




That is what heating men have been saying since the day we announced the No. 33 Safety Relief Valve and the No. 63 Low Water Cut-off illustrated here—a vital combination of controls for every automatically fired hot water heating installation. For example, a prominent jobber writes:

"We have been wondering . . . why someone didn't manufacture these two identical products, and now that they are available with a name that is tops in boiler equipment behind them, we want to promote them to our trade."

The answer is that this much needed combination presented a tough problem . . . required a lot of designing and re-designing—a lot of laboratory and field testing—before it could be properly solved.

But solved it is in the combination diagrammed—the No. 33 Safety Relief Valve to guard the boiler against excess pressure; the No. 63 to stop the burner in the event of low water.

When first proposed, this idea of using a low water cut-off on hot water heating boilers was met with jeers, but "they who came to scoff remained to praise!" What other provision, is there on a hot water boiler to stop the burner in the event of an *emergency* low water condition—an emergency caused by an unforeseen leak, or a prolonged discharge through the relief, or inoperative primary controls, or separation of the load from the boiler?

Yes, today's higher development of hot water heating has focused attention on every part of the system, and a vitally important part is its protection. Leading consulting engineers are recommending the combination shown here. First, a certified rated relief valve capable of discharging the maximum gross Btu. or heat output of the boiler under all conditions. Second, a low water cut-off to stop the firing in the event of low water.

The No. 33 when installed in conformity with its Btu. rating gives you this correct protection against excess pressure. The No. 63 is especially designed to give low water protection. Make no mistake about it; this combination will soon become a "must" on every automatically fired hot water heating job. You must know of many places where this combination is needed *now!* Write for bulletins.

**McDONNELL & MILLER, INC., 1316 Wrigley Bldg., Chicago 11, Ill.**

## Pressure Protection

*for the hot water heating boiler*

McDONNELL No. 33 Relief Valve

**TESTED, RATED, CERTIFIED by** *National Board of Boiler and Pressure Vessel Inspectors* **AUTHORIZED to carry A.S.M.E. Symbol.**

Patent Applied For

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1. Capacity of 242,900 Btu. per hr.—sufficient to take care of more than 70% of hot water heating boilers.
2. Ideal operating characteristics: low discharge rate at 30 lbs. pressure to relieve normal thermal expansion; high discharge rate under high velocity for emergency conditions.
3. Positive wide-open snap in emergency, thanks to "hydra-lift" design.

Throughout the No. 33 reflects McDonnell quality—hardened, ground, and polished stainless steel needle and seat giving leak-tight closure; easy-lift testing lever independent of pressure action; neat and compact design; remarkable simplicity that assures dependability. Ask for new bulletin.

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*for the hot water heating boiler*

Underwriters' Approved

McDonnell No. 63

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*Doing One Thing Well*

# McDONNELL

*Boiler Safety Controls*

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Extra "T" fitting for venting

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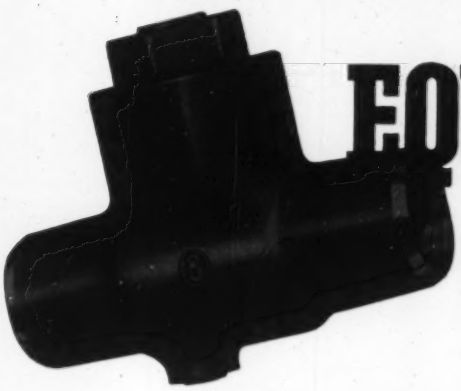

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To prevent tampering by the "home-plumber," manual operation of this valve is by Allen type wrenches or handy key provided.

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Street .....

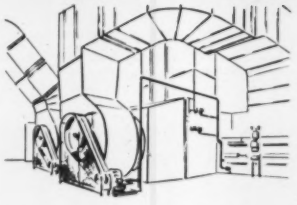
City ..... State .....

4022-V

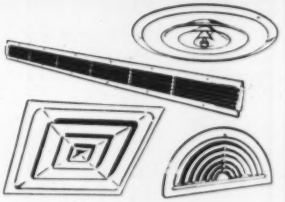
# Remember these facts...

## and you'll always specify Anemostat Air Diffusers

**ASPIRATION PRODUCES DRAFTLESS COMFORT**—The famous Anemostat aspiration and air expansion principles, illustrated and described below, distinguish Anemostat Air Diffusers from all other outlets and therefore assure the utmost in conditioned comfort . . . *no drafts . . . no stale air pockets . . . temperature and humidity instantly equalized.*



**SAVE ON DUCTS AND FANS**—You save on the initial cost of fans and ducts . . . and on the operating cost of fans . . . when you use Anemostat Air Diffusers. That's because these aspirating air diffusers permit the use of higher temperature differentials and higher supply air velocities than ordinary air outlets.



**A TYPE FOR EVERY NEED**—Round, semi-circular, square and straight-line . . . low pressure or high pressure! For every requirement there is a type and size Anemostat Air Diffuser exactly suited to your need . . . whether your designs call for ceiling or wall outlets . . . whether for comfort conditioning or industrial applications.

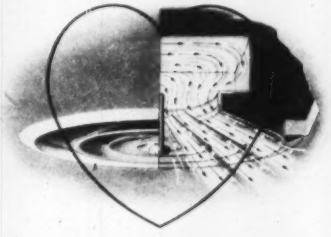
**SPEEDY INSTALLATION**—Anemostat Air Diffusers can be installed quickly and economically because of snap-on, ball-and-socket and other time-and-labor-saving features, depending on the type of Anemostat.

**PREDICTABLE PERFORMANCE**—You can count on precisely the air diffusion pattern you have selected because Anemostats are designed according to modern fluid flow theory and precision-manufactured to close tolerances.

**PATENT-PROTECTED DESIGNS**—Over a million dollars have been spent on research. Anemostat has protected its developments with more than fifty patents. That's why Anemostat is always a step ahead . . . why only Anemostat offers all these important features.

**The PROOF!** MORE THAN A MILLION ANEMOSTATS are now providing quality air diffusion in commercial buildings, industrial plants, hotels, stores, hospitals, theatres, restaurants, homes, buses, ships, railroad cars, military and commercial aircraft.

These installations required the solution of a great many different air distribution problems. Take advantage of this experience. What may appear to be a new air handling problem has probably already been solved by Anemostat. Call in your local Anemostat Sales Engineer who is backed by a most experienced engineering department.



**THE HEART OF THE MATTER...**

***Anemostat's Exclusive Aspiration Effect***

Due to its special design, the Anemostat distributes air of any duct velocity in a multiplicity of planes traveling in all directions. Simultaneously, the unit creates a series of countercurrents traveling toward the device which siphon into the device room air up to 35% of the supply air depending on the type and size of the unit. This room air is mixed with the supply air, within the Anemostat before the air mixture is discharged into the enclosure.

# ANEMOSTAT®

**DRAFTLESS *Aspirating* AIR DIFFUSERS**

*There is no "or equal"*

**ANEMOSTAT CORPORATION OF AMERICA**

**10 EAST 39th STREET, NEW YORK 16, N. Y.**

***REPRESENTATIVES IN PRINCIPAL CITIES***

"NO AIR CONDITIONING SYSTEM IS BETTER THAN ITS AIR DISTRIBUTION"

AC-1345

# Nothing heats better than Modine Convector Radiation . . . NOTHING LOOKS MORE BEAUTIFUL IN A BEAUTIFUL ROOM

To find out why the new Modine Convector is the *better* way to heat apartments, homes, schools, offices or hospitals, call your Modine Representative. He's listed in the "Where-to-Buy-it" section of your phone book. Ask to see a sample, or write direct. Modine Mfg. Co., 1509 Dekoven Avenue, Racine, Wisconsin.

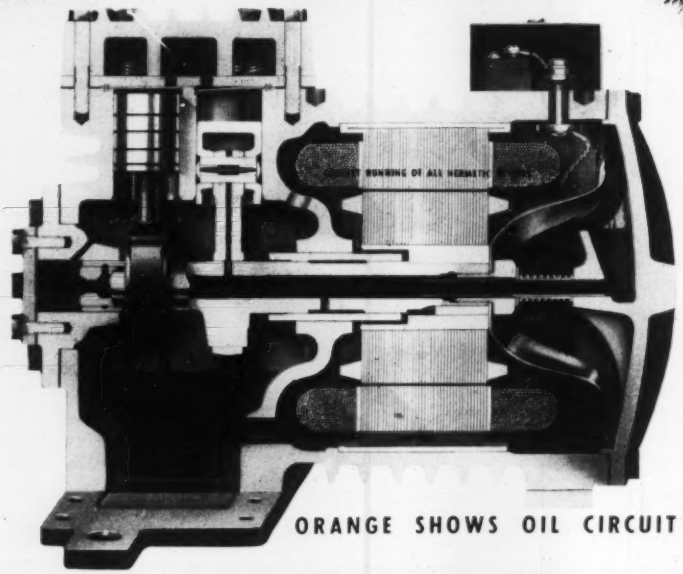
***Send for New Modine Convector Catalog Today!***

*Design and Mechanical Patents Pending*

**Modine**
**CONVECTORS**

R-1049

# FOR QUIET, ECONOMICAL AIR CONDITIONING




ORANGE SHOWS OIL CIRCUIT

# COPELAMETIC

## The ACCESSIBLE Hermetic

Smooth, quiet Copelametic gives the greatest value for your air-conditioning dollar. Look over the BTU ratings and you'll see what we mean. Copelametic is the hermetic that combines all the finest features of all types of units. It is field-accessible . . . never a reason to return it to the factory.

Copelametic eliminates belts, seals and manual motor oiling. The cutaway illustration shows how oil reaches all bearing surfaces by forced-feed lubrication. The one-piece compressor and motor housing maintains perfect alignment for bearings and cylinders. Large integral cast fins around the housing dissipate heat rapidly for highest efficiency. In addition, motors are water-cooled above 2 H.P.

Copelametic units can be used on any application now served by open units. Motors for any standard currents. Models from 1/6 H.P. to 7½ H.P., inclusive.

WRITE, WIRE or PHONE for full details.

**COPELAND REFRIGERATION CORPORATION · SIDNEY, OHIO**

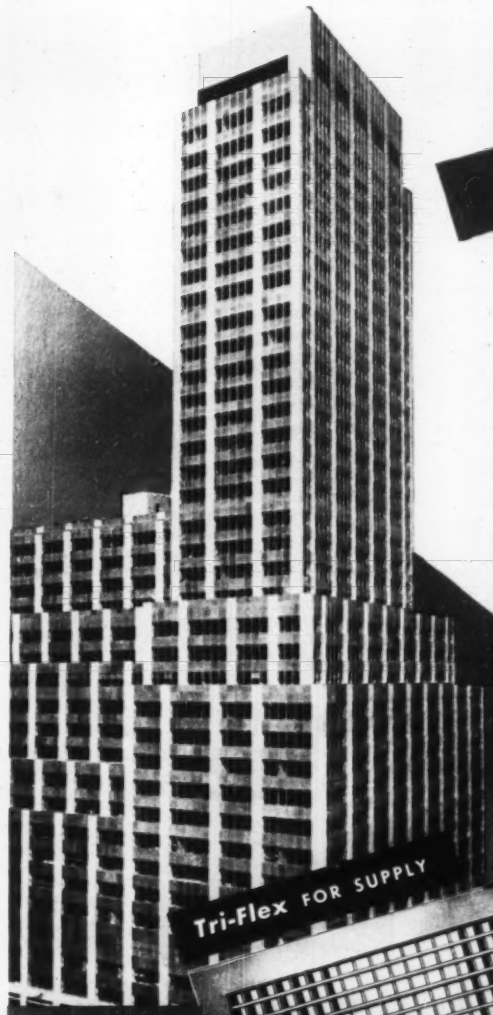
*Manufacturers of*

**REFRIGERATION UNITS (OPEN-TYPE AND COPELAMETIC), WATER COOLERS, REFRIGERATORS**

# Tri-Flex Aerovane

## in 100 Park Avenue

. . . one of New York City's newest and most impressive skyscrapers, an outstanding example of modern trends in structural design, efficiency, comfort. Completely air conditioned, the 36-story tower is equipped throughout with T&B Standards . . . Tri-Flex and Aerovane Grilles and Registers . . . specified by men who know the important relation between the satisfactory performance of an air conditioning system and the distribution equipment they select. With T&B Standards installed, they can be sure of maximum, flexible control of air delivery to meet every requirement . . . another trouble-free job!



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*Architects*

GEORGE A. FULLER COMPANY
*General Contractor*

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*Engineers*

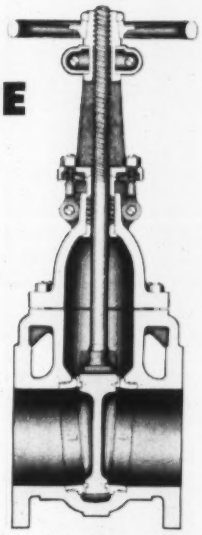
KERBY SAUNDERS, INC.
*Mechanical Contractor*

For quick selection . . . economy . . . prompt delivery . . . specify and install Tri-Flex and Aerovane Grilles and Registers. For complete details and engineering data, write for Catalog 485.

TUTTLE & BAILEY inc
NEW BRITAIN, CONNECTICUT

ST850

# Better piping for every job
# ...from one complete line...CRANE



No. 465½, Flanged Gate Working Pressures: up to 125 pounds steam; 200 pounds water, oil, gas. Sizes: 2 to 48-inch.

## BUILT STRONGER TO LAST LONGER

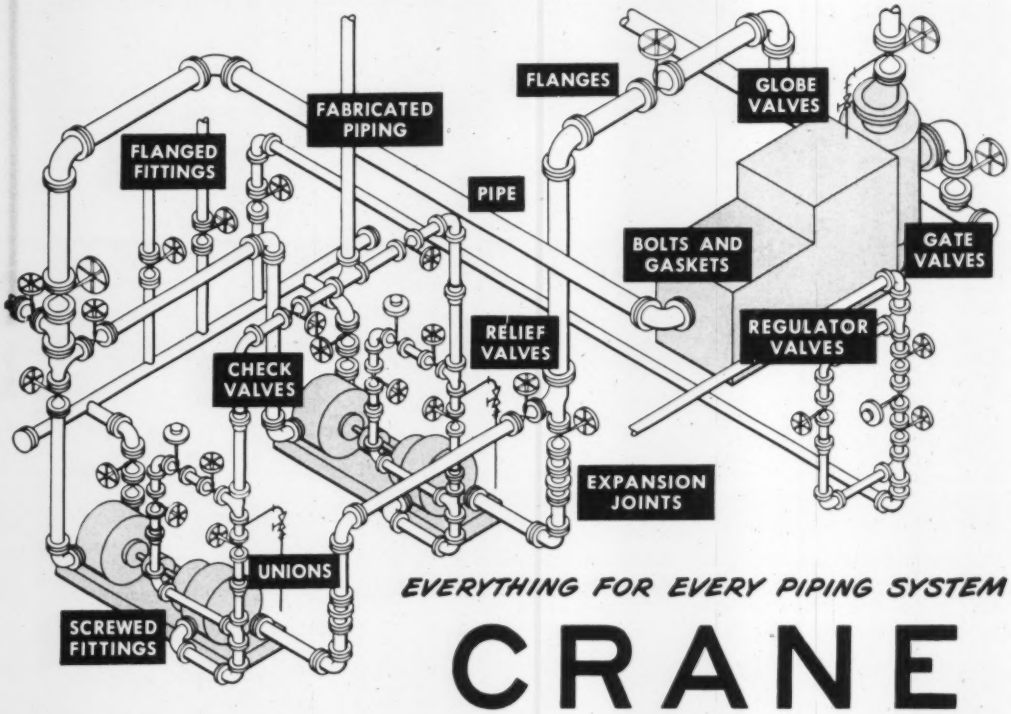
That's one reason Crane 125-Pound Iron Body Wedge Gates find such wide application. Improved elliptical body design with uniform wall thickness eliminates useless weight; provides high resistance to pressure loads. Tie-ribs between end and bonnet flanges increase resistance to line strains.

Check these other Crane design features. Greater flow capacity: straight-through ports assure streamline flow. Minimum maintenance: long disc guides reduce disc drag and wear on seating surfaces. Deep stuffing box—more packing—lengthens packing life. Easy operation: uniform pressure on packing eliminates stem binding. Flexible T-head disc-stem connection prevents side strain on stem.

Available in patterns for every need; non-rising stem, O. S. & Y., Quick-Opening and Underwriters'. Flanged or screwed ends. See your No. 49 Crane Catalog.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
*Branches and Wholesalers Serving All Industrial Areas*

***THIS BOILER FEED SYSTEM, FOR EXAMPLE, CAN BE COMPLETELY EQUIPPED ON ONE ORDER TO CRANE***




***EVERYTHING FOR EVERY PIPING SYSTEM***

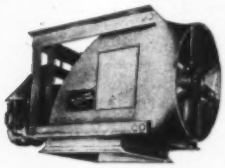
# CRANE

***VALVES • FITTINGS • PIPE • PLUMBING AND HEATING***

# WING VENTILATING EQUIPMENT

## WINGFOIL SAFETY VENTILATING FAN

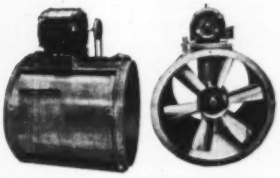
Distinguished for efficiency and rugged construction. The new Wingfoil fan wheel moves maximum volumes of air with minimum horsepower, due largely to its non-overloading feature. Sizes from 10" to 60" dia., with free air capacities from 825 to 59,000 CFM. Larger sizes on special order. Either direct or belt drive. Heavy steel guards provide safety.



## WINGFOIL DUCT FAN

**(Elbow Type)**

Designed to form an elbow in the duct system, the elbow-shaped housing in a strong rectangular frame permits installation with the inlet in any desired position. Motor and drive are outside the air stream, therefore remain cool, clean, and easily accessible. The new Wingfoil Fan has a remarkable "non-overloading" characteristic. Sizes 10" to 60"; capacities up to 85,000 CFM.

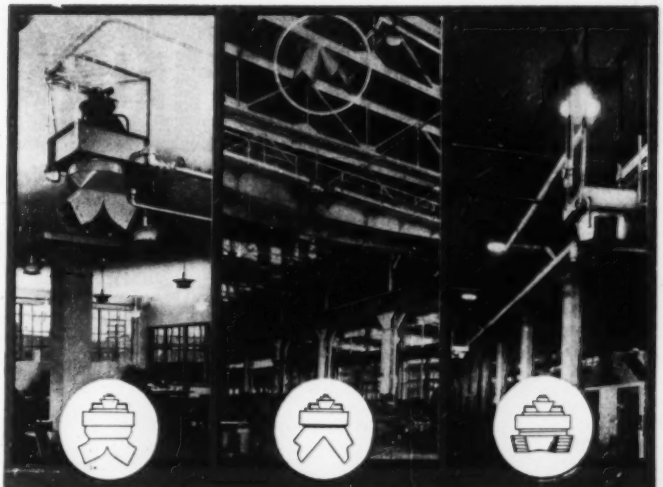


## WINGFOIL DUCT FAN

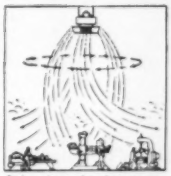
**(Straight Line Type)**

Designed to form a part of any straight run of duct. The motor is mounted on an adjustable base outside of the housing. V-belt drive is through an air tube carried across the housing and supporting fan shaft and bearings. Fan wheel is the new non-overloading Wingfoil Fan. Bearings are grease-sealed, requiring minimum of attention.

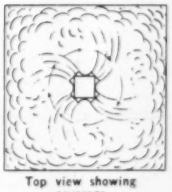
***WRITE FOR BULLETINS***



# The Discharge Outlets REVOLVE —only with WING unit heaters



Side view showing moving streams of heated air sweeping slowly around complete circle.



Top view showing coverage

The distinguishing feature of the WING Revolving Unit Heater, which makes its performance so outstandingly superior to other heaters is the Revolving Discharge Outlet. These outlets, moving slowly through a complete circle, flood the entire heating area with a blanket of fresh, live, warm air. The gentle air motion caused by the constantly changing directions of the heated air from the revolving outlets creates a refreshing, stimulating atmosphere beneficial to employee morale and productivity. Hot blasts and chilly areas are eliminated. Get complete information by writing today for Bulletin HR-5.

**L. J. Wing Mfg. Co.**

**Executive Offices and Factory: 140 Vreeland Mills Road, LINDEN, N. J.**

*Canadian Factory: Montreal, Canada*

Manufacturing Licensee for Wing Unit Heaters in Western Europe—
ETABLISSEMENTS WANSON—
9, rue Mogador, Paris 9e, France
Nouveau Boulevard de la Woluwe,
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# Wing

## Revolving UNIT HEATERS

# WORTHINGTON AIR CONDITIONING REPORT

**WORTHINGTON PUMP AND MACHINERY CORPORATION**
**HARRISON, NEW JERSEY**

*Specialists in air conditioning and refrigeration for more than 50 years*

## We're Part of the HOSPITALITY at the Westward Ho

If ever the name of a hotel suggested an invigorating atmosphere, it's the spectacular Westward Ho in Phoenix.

Internationally famous as a resort hotel, the Westward Ho gives its guests the year-'round comfort of air conditioning, furnished by Worthington equipment.

Five years ago, when the hotel wished to expand its air conditioning, a Worthington centrifugal compressor was installed, with the original unit put aside for stand-by service.

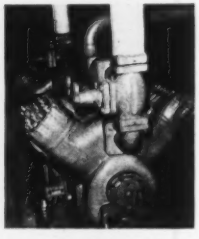
Last year, an annex to the hotel was built, and Worthington equipment was again selected: two Freon reciprocating compressors and one condenser.

Distributor: Frank Harmonson Co., Phoenix.

*Westward Ho is Phoenix' largest hotel. It is completely Worthington-conditioned.*

*La Mina Room, one of the several dining rooms in the Westward Ho.*

*Cool, comfortable air, Worthington-supplied, adds to the charm of this typical suite in the Westward Ho annex.*



*Two Worthington Freon-12 6HF4 Compressors installed in the new annex.*

## Now They Trade in Comfort on the New Orleans Exchange

*New Orleans Cotton Exchange —completely air-conditioned by Worthington.*

*Consulting Engineers—Leo S. Weil and Walter B. Moses.*

*Contractor—Mayer Godchaux*

During its nearly 80 years, The New Orleans Cotton Exchange has undoubtedly observed many scenes of feverish trading, but since 1948 the air, at least, has maintained a moderate temperature.

Worthington centrifugal refrigeration makes the difference. The Worthington system has a capacity to cool 420 gpm of water from 55.6 F to 46 F when supplied with 545 gpm of condensed water at a maximum of 87 F. Capacity rating for the entire system is 160 tons.

## Worthington Makes a Hit in Sangamo's Auditorium

*Auditorium in plant of Sangamo Electric Co., a leading manufacturer of electric measuring and control equipment, Springfield, Illinois.*

The modern auditorium built by Sangamo Electric Corporation to be used as a meeting place for employee training courses, sales conferences, and employee organizations, provides the year-'round comfort of Worthington air conditioning.

The equipment, installed by Henson Robinson Co. of Springfield, Ill., includes a 3HF6 Freon-12 compressor, an AVY air conditioning unit, and an ECZ evaporative condenser. The system is rated at 15 tons and handles 4500 cfm. 95% of the condenser water is saved for re-use.

Here's how the system operates. A single off-on wall switch controls the entire system, with inter-locks for proper sequence of operation. A room-type cooling thermostat actuates a solenoid valve in the Freon liquid line. A heating thermostat actuates a modulating-type steam valve and modulating-type motor connected to air conditioning face and by-pass damper.

A manual modulating-type control and motor secure the desired mixture of fresh and recirculated air entering the unit (maximum 3000 cfm). Automatic change-over from heating to cooling cycle, or vice versa, is provided.

In order to prevent freezing of water in the evaporative condenser, located in the equipment room, a duct arrangement with temperature controller and damper motor was installed. This insures trouble-free operation when outside temperature falls below 35 F, since the evaporative condenser supply air is taken from the equipment room.

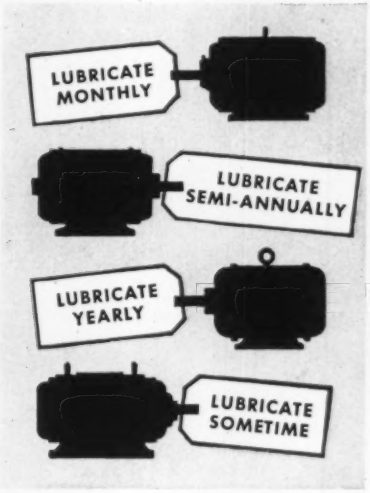
**WORTHINGTON**

**AIR CONDITIONING AND REFRIGERATION**

A complete line . . . in which *all* the vital components are *made*, not just assembled by Worthington. For more worth with Worthington, see your nearby Worthington distributor (consult Classified Telephone Directory).

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



# Why take a chance with "Once-in-a-while" lubrication?

Why fuss with motors that require lubrication "every so often?" Whether it's monthly, yearly, every two or three years, or just an indefinite "sometime," it is as much trouble remembering when to lubricate, as it is to do the lubricating. And it certainly isn't a very good way of making sure bearings get proper greasing attention.

There *is* one way to be *sure*. That's with Life-Line motors. Lubrication is *positive*. Bearings are pre-lubricated and factory-sealed. *No* further lubrication is required!

This is the modern way of lubricating motors. Development of special lubricants, up-to-date manufacturing methods and special seals have made it possible.

Records of nearly half a million motors, operating in every type of industry, indicate that pre-lubricated bearings offer: an average saving of $2.70 yearly per motor . . . 41% fewer motor outages due to faulty lubrication . . . complete freedom from lubrication attention.

Today, periodic lubrication is a costly nuisance. So why take a chance with it when Life-Line offers positive lubrication at no extra cost. See for yourself. Ask your Westinghouse representative for a copy of "Facts on Pre-Lubricated Bearings," B-4378, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-21559

*If you figure LIFE-COSTS . . . you'll figure LIFE-LINE*

# DEPENDABILITY

## THE TRUE MONEY-SAVER IN EVERY "BUFFALO" PUMP

OLD FAITHFUL GEYSER, spouting 12,000 gallons of scalding water 150 feet into the air every 66½ minutes, has been a byword for DEPENDABILITY to millions of tourists since its discovery in 1870.

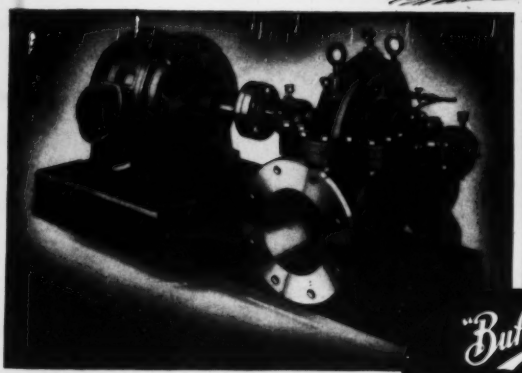
"BUFFALO" PUMPS have an equally strong reputation for dependability with thousands of users. AND THIS MEANS ECONOMY IN EVERY PUMPING JOB! It means freedom from costly repairs—and, more important, freedom from long shutdowns, which are the big cost of pump failure.

Why take a chance? Back up your liquid-moving jobs with "Buffalo" Pumps and enjoy the true economy in this dependability. Call on your nearby "Buffalo" Engineering Representative for complete information.

**BUFFALO PUMPS, INC.**

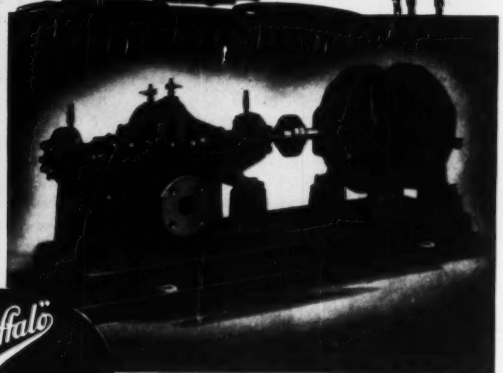
171 Mortimer St., Buffalo, N. Y.
Canada Pumps, Ltd., Kitchener, Ont.

Branch Offices in All Principal Cities

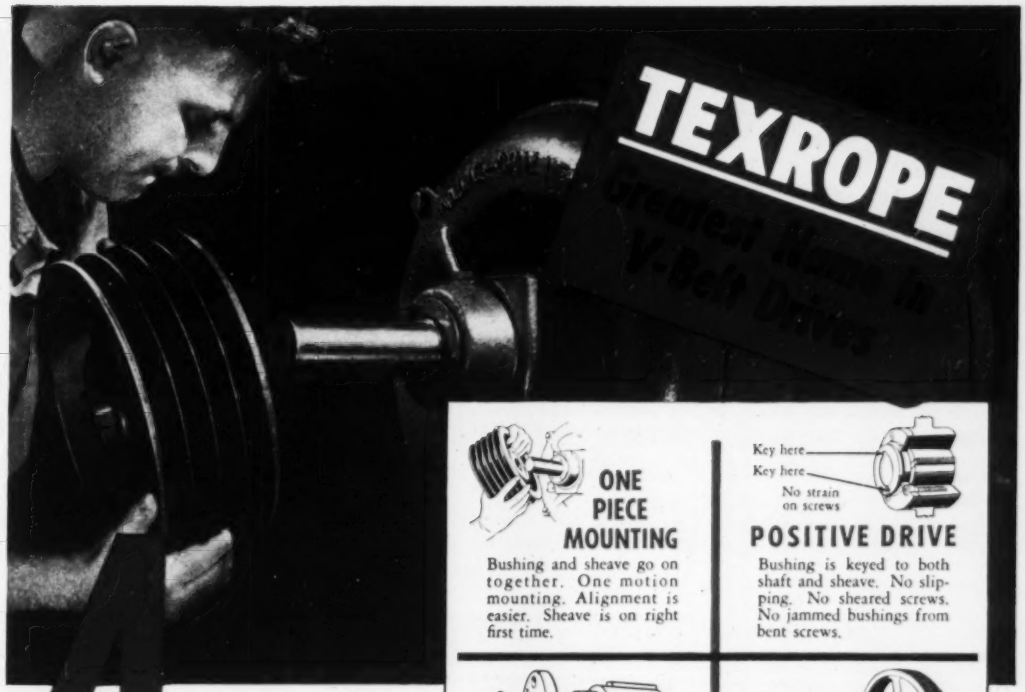


"Buffalo" Class "SL" Pumps are widely used on air conditioning systems and for other clear water service. Write for Bulletin 955-N and see their heavy-duty precision construction.

"Buffalo" CENTRIFUGAL PUMPS



"Buffalo" Class "RR" Pumps for boiler feed and general service are popular with users for their efficiency and durability on the job—in models to deliver from 20 to 900 gpm at heads up to 1500 ft. Write for Bulletin 980-B.





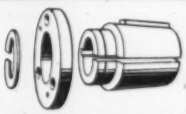

**ONE PIECE MOUNTING**

Bushing and sheave go on together. One motion mounting. Alignment is easier. Sheave is on right first time.



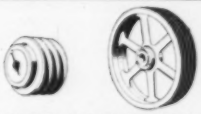

**POSITIVE DRIVE**

Bushing is keyed to both shaft and sheave. No slipping. No sheared screws. No jammed bushings from bent screws.



**FULL CIRCLE GRIP**

Bushing split full length with separate collar. Grips shaft full length around full diameter. No forcing or distortion. Grip easily broken. No hammering.



**WIDE SIZE RANGE**

*Magic Grip* sheaves are available from 3" pitch diameter up. Style NC bushing for smaller sizes and Style C bushing for larger sizes.

# 4 BIG ADVANTAGES!

# MAGIC GRIP SHEAVE

YOU CAN MOUNT a *Magic Grip* sheave faster than any other sheave you can buy . . . and demount it just as fast. When you mount a *Magic Grip* sheave it runs true. It will not slip or jam. It always comes off easily.

Even if you don't change sheaves often, you should have *Magic Grip* sheaves on every drive to eliminate the possibility of shaft and bearing damage when ordinary sheaves are hammered or pried on or off.

## WIDEST V-BELT LINE

Get everything you need for your V-belt drives from one reliable source. *Texrope* offers the broadest line of V-belts, standard and variable speed sheaves and speed changers in the industry. And you also get the extra engineering skill that comes from having more industrial V-belt installations than any other manufacturer.

Get your copy of the 144 page *Texrope* Pre-Engineered Drive Manual from your A-C Authorized Dealer or Sales Office or write for Bulletin 20B6956.

A-3022

ALLIS-CHALMERS, 1171A SO. 70 ST.
MILWAUKEE, WIS.

**Sold . . .**
**Applied . . .**
**Serviced . . .**

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

**MOTORS** — ½ to 25,000 hp and up. All types.

**CONTROL** — Manual, magnetic and combination starters; push button stations and components for complete control systems.

**PUMPS** — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

*Texrope* and *Magic Grip* are Allis-Chalmers trademarks.

# ALLIS-CHALMERS

9-X-14

## IN THE REFRIGERATION FIELD,

the surest and safest way to prevent fittings leaks is to install W-S Double-diamond Screw End and Socket Weld Forged Steel Fittings.

Designs are carefully engineered. Basic Materials are selected from a wide choice of carbon, stainless and alloy steels. Drop forging and precision machining makes them light in weight, assures accuracy of finish, and, all are instrument inspected for perfection of threads, sockets, angles and concentricity. Investigate them today.

Write for Bulletin A3-50. For information on stainless and alloy steel fittings ask for Bulletin S-1.

SOLD THROUGH LEADING DISTRIBUTORS EVERYWHERE

SPECIFY...

W-S

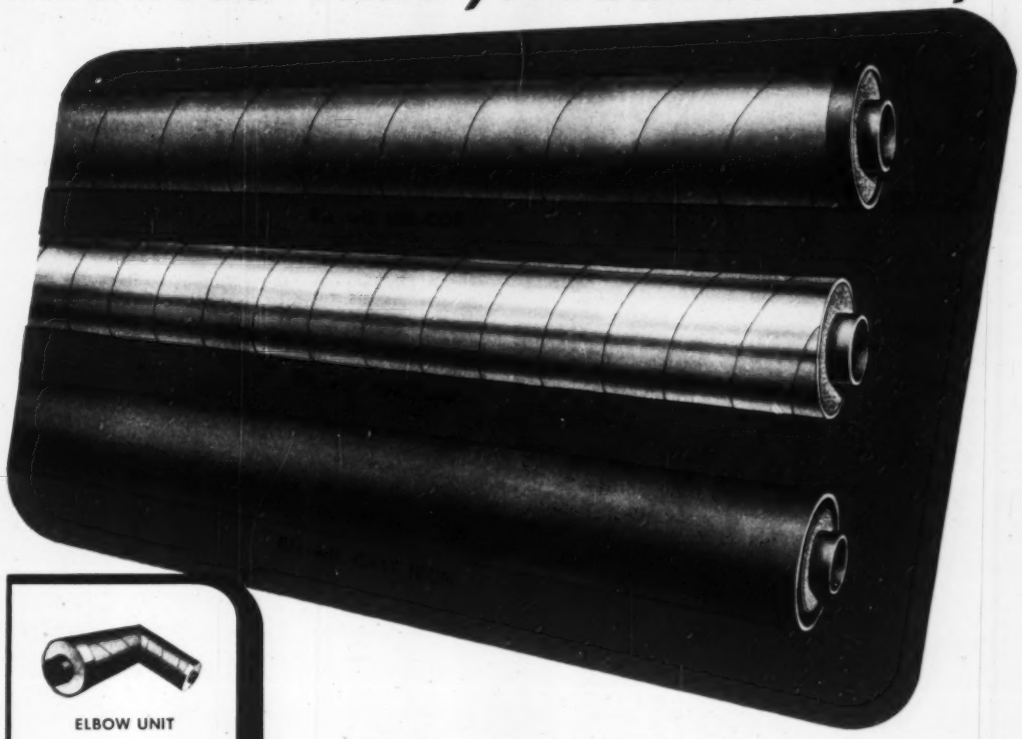
FORGED STEEL FITTINGS

DISTRIBUTORS PRODUCTS DIVISION **WATSON-STILLMAN** ESTABLISHED 1848 • ROSELLE, NEW JERSEY

Designers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment

# RIC-WIL IS YOUR SOLUTION TO INSULATED PIPING PROBLEMS

## ...Saves Time, Reduces Cost!



Take the finest known insulating, protective, and conveying materials. Add skilled prefabrication of insulated piping in modern plants under ideal conditions. Result—Ric-wiL Prefabricated Insulated Piping for underground or overhead use.

Add to these a full line of accessory units such as expansion loops and joints, tees, elbows, etc. Combine these with forty years of production engineering and installation experience, and the highly skilled and complete Ric-wiL engineering service . . . you get low installation cost and high operating efficiency of Ric-wiL Prefabricated Insulated Piping Systems. For service and responsibility call on Ric-wiL.

Our representative will be glad to discuss your specific problem at your request and without obligation.

For full technical information on Ric-wiL Insulated Piping Systems, call or write the Ric-wiL office nearest you or Dept. 1-Y in Cleveland, Ohio.

**RIC-WIL**

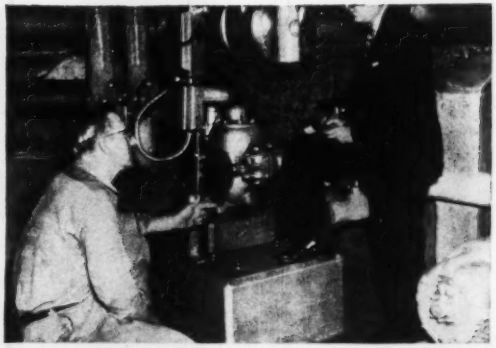
**INSULATED PIPING SYSTEMS**

**THE RIC-WIL COMPANY · CLEVELAND, O.**

**OVERHEAD** **UNDERGROUND**

**FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS**

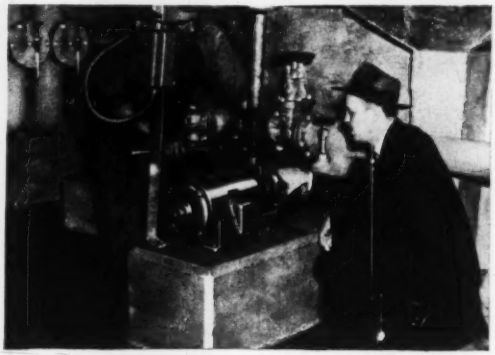
Electrifugal PUMP



ESTIMATING correctly, finding the lowest cost unit that will do the job, involves more than just looking up a price.

PLANNING installation with A-C pump engineer from beginning may save hours of engineering work, eliminate costly errors.

INSTALLING a pump correctly is one of the big secrets of good pump performance. The A-C pump engineer will advise you here, too.



# COMPETENT ENGINEERING HELP...

## *yours with every Electrifugal Pump*

YOU GET MORE than a good pump when you buy an *Electrifugal* pump. You get practical engineering help from a skilled and experienced pump engineer. He will sit down with you in the planning stage, offering his advice and know-how to help you design a better system at lowest cost. He will carry the job all the way through, even to showing you the quickest, easiest way to install a pump correctly. Often he can save you many dollars by suggesting a change in piping, valving or other arrangement.

Allis-Chalmers pump engineers are trained to understand the problems of the air conditioning industry. They can save you much costly engineering work and *guarantee* a satisfactory job.

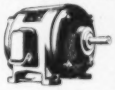
Remember, too, Allis-Chalmers can supply pumps, motors, *Texrope* V-belt drives and motor control for immediate delivery from field stocks. Fast service. No waiting.

You can make money by relying on Allis-Chalmers pump engineers. You can get in touch with one by calling your Allis-Chalmers Authorized Dealer or Sales Office. And be sure your "sources-of-equipment" file contains a copy of A-C Bulletin 52B6059. Write today. A-2987

ALLIS-CHALMERS, 1171A SO. 70 ST.
MILWAUKEE, WIS.

***Sold . . .***
***Applied . . .***
***Serviced . . .***

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.



**MOTORS** — ½ to 25,000 hp and up. All types.

**CONTROL** — Manual, magnetic and combination starters; push button stations and components for complete control systems.

**TEXROPE** — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

*Electrifugal* and *Texrope* are Allis-Chalmers trademarks.

A-C ALLIS-CHALMERS

# ALLIS-CHALMERS

# "HOTTER, SOONER" Saves YOU MONEY

Yarway Impulse Steam Trap with new stainless steel body.

Yarway Impulse Steam Traps get equipment hot and into production *faster*. Extra profits!

Then they keep it *continuously* at peak operating temperatures for maximum production. More extra profits!

What's the reason for *hotter, sooner?* Just this. When steam is turned on, Yarways open wide, discharging the air and condensate *in a hurry* —closing only when steam arrives. Then, when operating temperature has been quickly reached, the little valve (only moving part) literally *floats on the load*... discharging heat-retarding condensate as soon as it forms instead of waiting for quantities to accumulate. Thus equipment is held at peak operating efficiency.

Other economical features of Yarway traps—minimum maintenance, easy installation, low initial cost.

More than 600,000 Yarways have already been installed. Sold by distributors throughout the world.

Try a Yarway today... standardize on Yarways tomorrow.

**YARNALL-WARING COMPANY**
**107 MERMAID AVENUE, PHILA. 18, PA.**

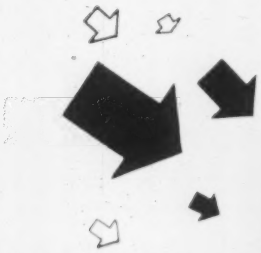
Nest of Yarway traps installed with Yarway Strainers on cloth dryer. Note small space required.

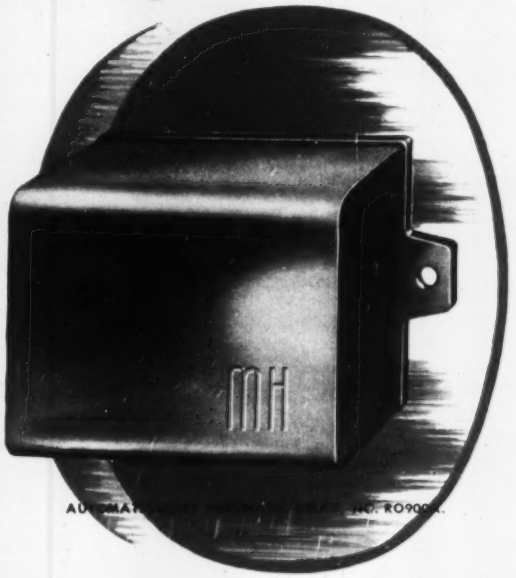
*Stainless Steel Body*

**YARWAY IMPULSE STEAM TRAP**

# *The* NEW HONEYWELL AUTOMATIC-RESET PNEUMATIC RELAY

## Maintains Exact Temperatures... Under Any and All Load or Lag Conditions





INTERESTED in the *best* pneumatic control performance available?

Here it is! Honeywell's new Automatic-Reset Pneumatic Relay. It maintains exact temperatures under any conditions by using the new principle of *reset action.* Reset action, when added to a proportional-acting pneumatic control system, causes the valve (or motor) to move farther in response to a given load change than with proportional control alone—just enough farther to restore the temperature approximately to the set point. Thus most of the offset characteristic of proportional control is eliminated.

**WITH *RESET ACTION* YOU BENEFIT FOUR WAYS**

**BETTER CONTROL**—You're assured of a system that maintains the temperature set on the controller.

**GREATER STABILITY**—Because *reset action* reduces offset by 90% and allows wider throttling range settings, the system will have greater stability with no hunting or cycling.

**MORE COMFORT**—No matter how severe or mild the heating requirements become, *reset action* holds the temperature just as it is wanted for comfort. There's no need to worry about changing conditions causing the temperature to drift away from the thermostat setting.

**SIMPLE INSTALLATION**—The Automatic-Reset Relay can be inserted in a new pneumatic control system at any point in the branch line where it is convenient to do so. It may also be added to existing control systems merely by cutting it into the controller branch line and supplying it with main air pressure. This single, inexpensive unit can be used with any standard pneumatic controller and can be applied to most existing systems without replacing the primary controller.

The Honeywell Automatic-Reset Relay is today's outstanding news in pneumatic control. You'll want to be fully informed. Call the Honeywell office in your city, or address a card to Minneapolis-Honeywell, Minneapolis 8, Minnesota. In Canada: Toronto 12, Ontario.

MINNEAPOLIS **Honeywell**

FIRST IN CONTROLS

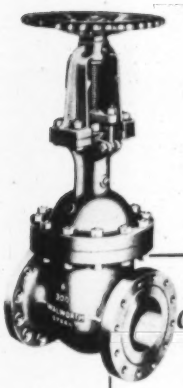
77 BRANCHES FROM COAST TO COAST WITH SUBSIDIARY COMPANIES IN: TORONTO • LONDON • STOCKHOLM • AMSTERDAM • BRUSSELS • ZURICH • MEXICO CITY

**WALWORTH**

# Cast Steel Gate Valves

***Series 150 and 300***

***Wedge Gate — Outside Screw and Yoke***



Sectional view of Series 300

**Big 8-Point Superiority!**

**Gland** clearances are such that stem cannot be scored if gland should be tightened unevenly.

**Deep Stuffing Boxes** in all sizes (2" to 24") insure tightness and maximum packing life – costly leaks are eliminated.

**Bonnets and Bodies** are engineered to withstand pressure and minimize distortion – they're tough, durable, dependable.

**Heavy Steel Walls** provide extra strength and longer life.

**Integral Body Guide Rib Faces** are machined to insure accurate disc seating.

**Seat Rings** are bottom seated – not flange type. No recess exists at back of ring – hence no turbulence, erosion, or pressure drop.

**Streamlined Ports** allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

**Valves** regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

***For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.***

For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

**WALWORTH**

**valves and fittings**

**60 EAST 42nd STREET, NEW YORK 17, N. Y.**

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

# HOW YOU CAN PUT YOUR

## "BUFFALO" AIR CONDITIONING CAN DO A *Complete* PROCESSING JOB

The industrial uses of air multiply daily! It's the recognized "comfort medium" that makes workers more efficient and productive. It's a "safety factor" which can minimize explosion dangers, fume poisoning and risk of "accident-prone" workers. *It can control your product quality, your turnout—and your profits—to a remarkable degree!* And present-day "Buffalo" Air Conditioning Units can create and maintain *any* air condition you require. You can wash your air, heat or cool it as desired, control the humidity exactly, collect dust by-products from your air—easily, continuously and economically—with "Buffalo" equipment.

## "BUFFALO" FANS OFTEN THE ONLY *Air Conditioning* YOU NEED

Modern, efficient fans perform many of the functions of air conditioning. A "Buffalo" Limit-Load Fan, for instance, can "cool by ventilation" — circulating air continuously throughout the plant and causing a cool, comfortable feeling. "Buffalo" Fans can remove harmful dust, fumes and excessive moisture from your plant air. In these and dozens of other ways, "Buffalo" Fans can put your air to profitable use.

## IT COSTS YOU LESS THAN YOU'D THINK

"Buffalo" equipment is permanent equipment. Flimsy, lightweight "package" units are not part of our line. The results? Many "Buffalo" air washers are still giving efficient daily service over FORTY YEARS AFTER INSTALLATION. Many "Buffalo" Fans are OVER FIFTY YEARS OLD. Here, certainly, is long-run economy!

*Why not talk over YOUR air and its profit possibilities with a trained "Buffalo" engineer? Write us — we'll have him call on you . . . AT NO OBLIGATION!*

Buffalo FIRST FOR FANS

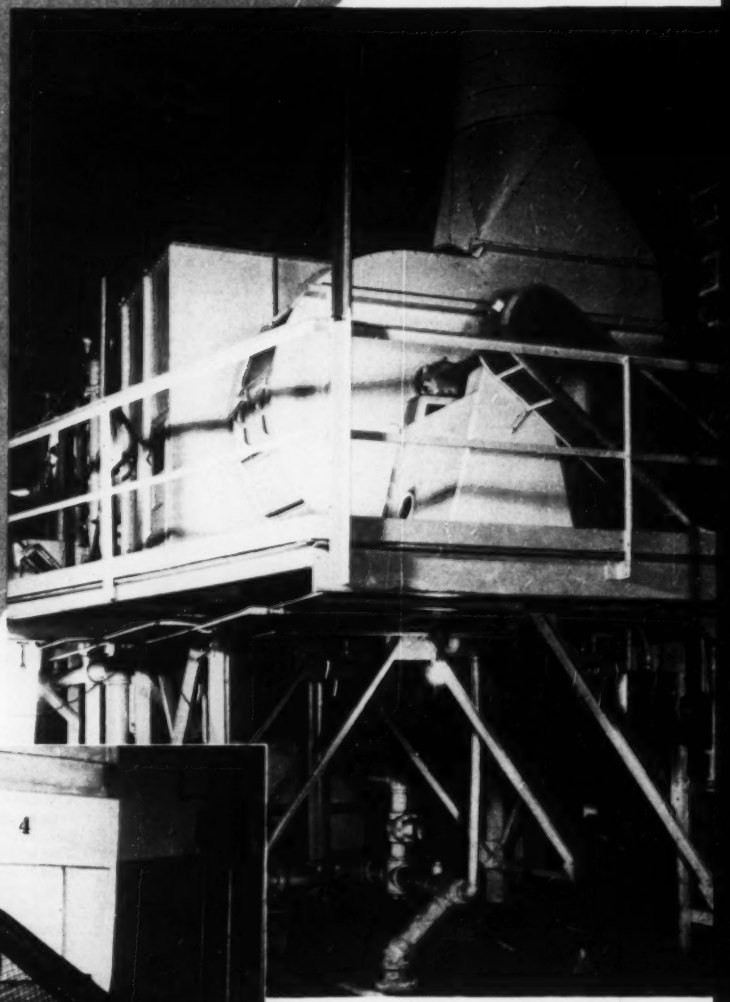
## BUFFALO FORGE COMPANY

171 MORTIMER STREET BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

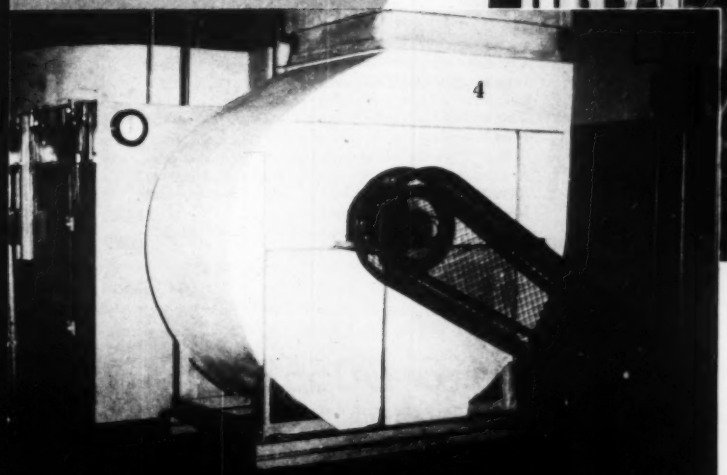
Branch Offices in All Principal Cities

# AIR TO BEST USE.



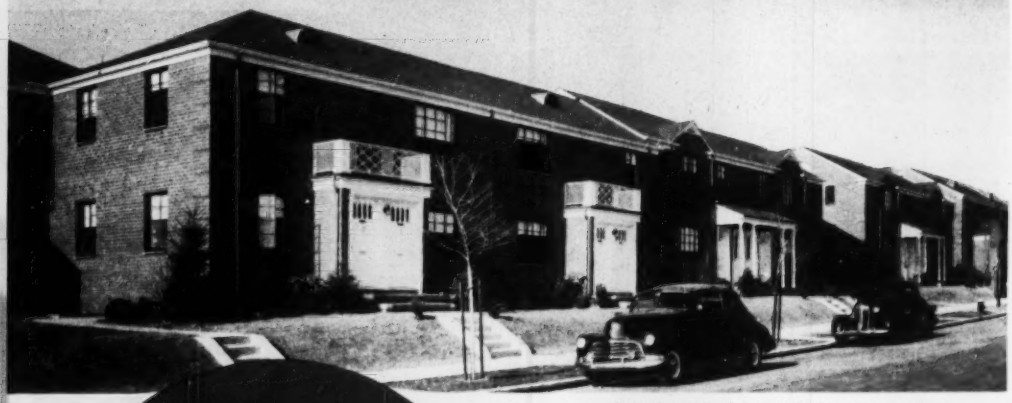
"Buffalo" Limit-Load Fan and Air Washer cleaning foundry air.

"Buffalo" "LL" Fan and Comfort Conditioning Cabinet supplying conditioned air in a large office building.

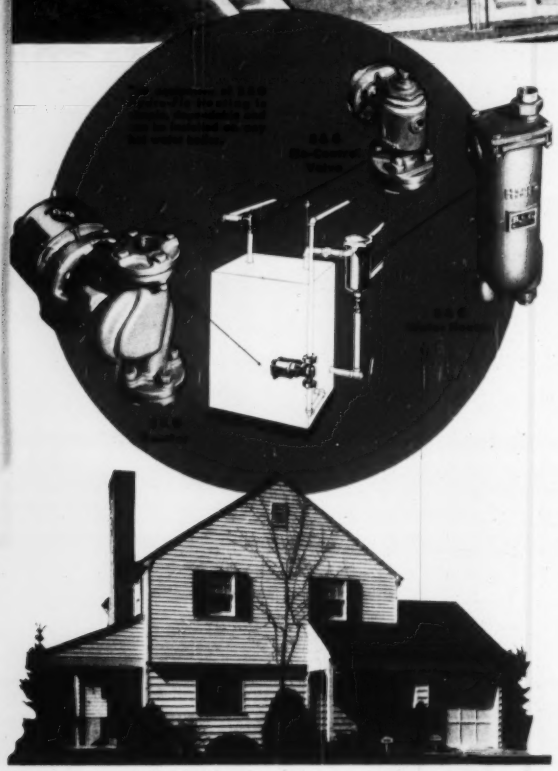


# NO JOB TOO BIG OR TOO SMALL

## FOR B&G *Hydro-Flo* HEATING



*Units of a 576-family housing development equipped with B&G Hydro-Flo Heating.*



*No fuel wasted—no uneven temperatures in this home with B&G Hydro-Flo Heating.*

### This Forced Hot Water System sets new standards of comfort and economy

Forced hot water has inherent advantages which mean better heating in buildings of every size and description. That's why you find B & G *Hydro-Flo* Systems in small low-cost homes and in buildings where radiation is measured in hundreds of thousands of square feet.

B & G *Hydro-Flo* Heating provides *controlled radiant* warmth . . . assures both economy of fuel and supreme comfort in any weather. For heat distributors you have a choice of radiators, baseboards, convectors or that miracle of modern heating—*completely concealed radiant panels!*

### Uniform indoor temperature— no wasteful overheating

The heat supply is always matched to the weather —so exactly that from Fall to Spring indoor temperature is kept constantly at the comfort level. The B & G *Hydro-Flo* System furnishes *just enough* heat . . . never burns fuel needlessly.

B & G *Hydro-Flo* Heating is not for just a few. Everyone can enjoy its benefits because this great advance in living comfort comes within the cost limits of even modest homes.

Send today for free booklet, "Capture the Sun with B & G *Hydro-Flo* Heating."

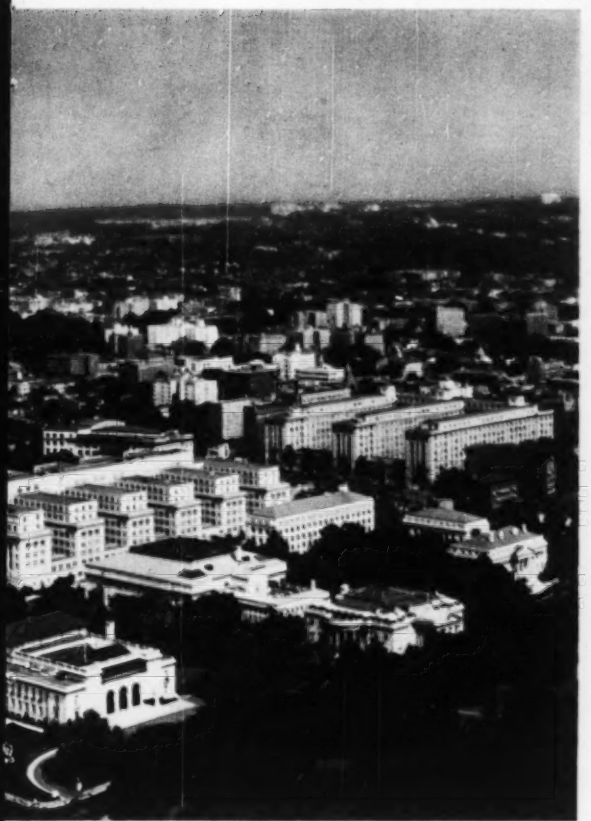
**BELL & GOSSETT** *Company*

Dept. BM-5, Morton Grove, Ill.

*Canadian Licensee: S. A. Armstrong, Ltd. 1400 O'Connor Drive, Toronto 13*

*Reg. U. S. Pat. Off.

## American Blower—a time-honored name in air handling



Venturafin Unit Heaters

Mechanical Draft Fans

Utility Sets

Ventura Ventilating Fans

Dust Collectors

Air Washers

Industrial Fans

Heating and Cooling Coils

Air Conditioning Equipment

**In Washington,** as in other cities, American Blower Air Handling Products serve commerce, industry and public utilities. For air handling data in the Washington area, call American Blower—National 8120. Elsewhere, consult your phone book.

**All air** handling equipment is not alike. There's a vast difference in quality, design, quietness, operating costs and efficiency. Look before you buy and you'll buy American Blower products—the accepted quality standard—proved in test after test by buyers.

# Air is free . . . use it profitably!

The buyer of an American Blower Kitchen Fan . . .

The public utility which orders American Blower Forced and Induced Draft Fans and Fluid Drives . . .

The cement plant which installs American Blower Air Handling Equipment and Dust Collector . . .

All these buyers get one thing in common.

They get equipment which is built by a manufacturer with a background of 69 years' experience—equipment which is tested in accordance with the Standard Test Code and carries Certified Ratings. In addition, they know that, whether the product costs $43.75 (price of an Aeropel) or runs into thousands (power plant equipment), they get the benefits of American Blower's research and high quality.

To buyers of air handling equipment, these plus values insure lower operating costs and long, dependable service.

To contractors with an eye to the future, these same factors insure satisfied customers and fair profits.

Our nearest branch office will give you full data.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

YOUR BEST BUY

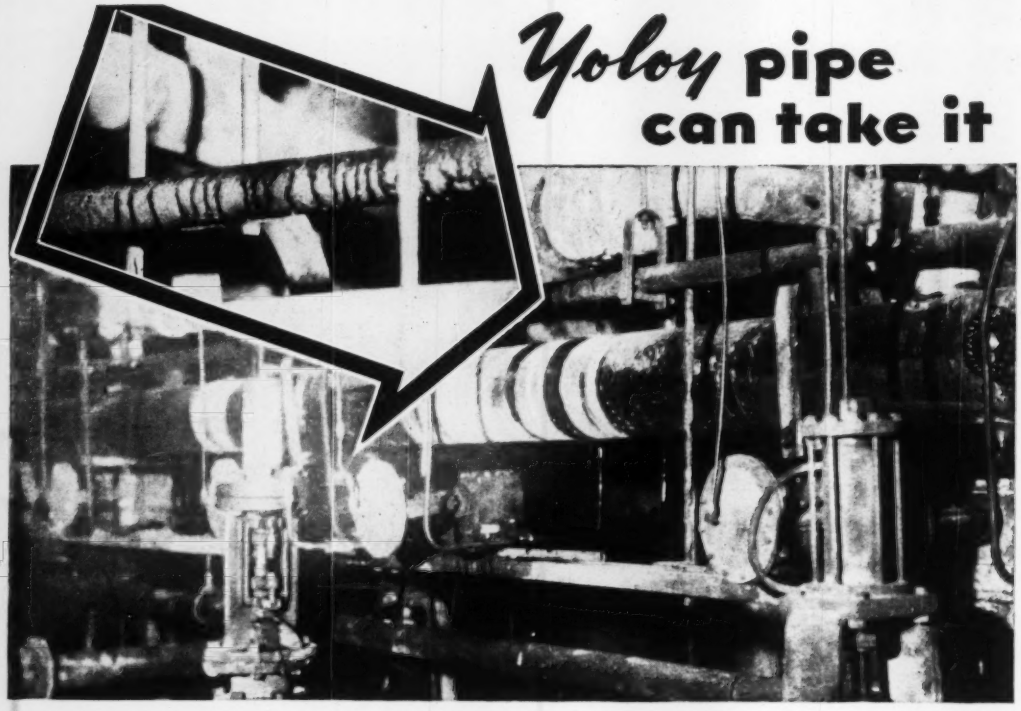
**AMERICAN BLOWER**

AIR HANDLING EQUIPMENT

*Serving home and industry*

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

# *Yoloy* pipe can take it



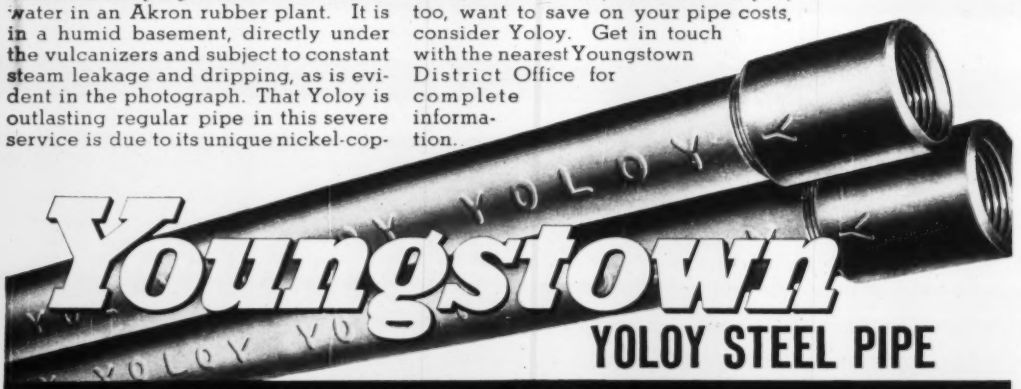
In the arrow inset above, you see a piece of 1½" Yoloy Continuous Weld Pipe. Subject to continual corrosion, it is still in use after nearly 4 years. Regular pipe used here previously had failed and been replaced at least once a year.

This Yoloy pipe is in a booster pressure line carrying 500 P.S.I. raw cold water in an Akron rubber plant. It is in a humid basement, directly under the vulcanizers and subject to constant steam leakage and dripping, as is evident in the photograph. That Yoloy is outlasting regular pipe in this severe service is due to its unique nickel-copper content or low-alloy composition.

In this installation Yoloy pipe has saved the manufacturer 50% of his pipe cost, 75% of his installation labor cost and has avoided three costly shutdowns for pipe repairs.

Yoloy standard weight black pipe is carried in stock for prompt delivery in sizes from ⅜" to 3", inclusive. If you, too, want to save on your pipe costs, consider Yoloy. Get in touch with the nearest Youngstown District Office for complete information.

THE YOUNGSTOWN SHEET & TUBE CO. 1900 YOUNGSTOWN 1950 50 YEARS OF SERVICE




# Youngstown YOLOY STEEL PIPE

**THE YOUNGSTOWN SHEET AND TUBE COMPANY**

*Manufacturers of Carbon, Alloy and Yoloy Steel*

General Offices — Youngstown 1, Ohio

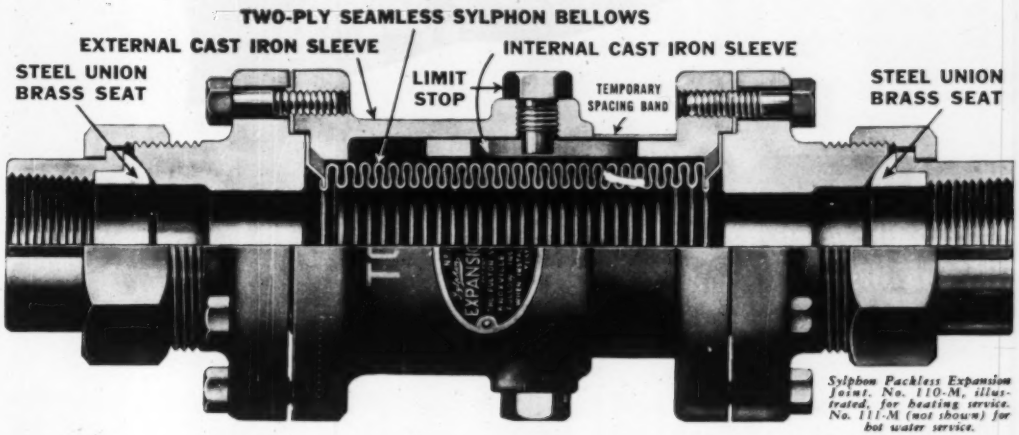
Export Office - 500 Fifth Avenue, New York

PIPE AND TUBULAR PRODUCTS - CONDUIT - BARS - RODS - COLD FINISHED CARBON AND ALLOY BARS - SHEETS - PLATES - WIRE - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - RAILROAD TRACK SPIKES.

*"Everything's under Control"*

# *Increase rentable space, reduce costs with*

# SYLPHON PACKLESS EXPANSION JOINTS




*Sylphon Packless Expansion Joint, No. 110-M, illustrated, for heating service. No. 111-M (not shown) for hot water service.*

**Increase Rentable Space** . . . Used in place of expansion loops, Sylphon Packless Expansion Joints eliminate useless building height—make possible more revenue-producing space. And, they simplify building plans—save on materials and construction costs.

**Reduce Heating Costs** . . . They assure a continuous, sealed piping system, free from wasteful leaks and costly repacking of ordinary expansion members. Steam or hot water is distributed throughout tall buildings with greatest economy of space—and with a sizeable reduction in heating costs.

The number of component parts of these Joints is small, assuring simplicity and compactness. Now equipped with two-ply monel metal Sylphon bellows which takes care of any movement of the heating riser. The entire unit is rugged and dependable, built for long, trouble-free service. Thousands are serving and saving in prominent buildings. For complete information send today for free catalog JH-65.

*Temperature Controls • Bellows Devices • Bellows Assemblies*

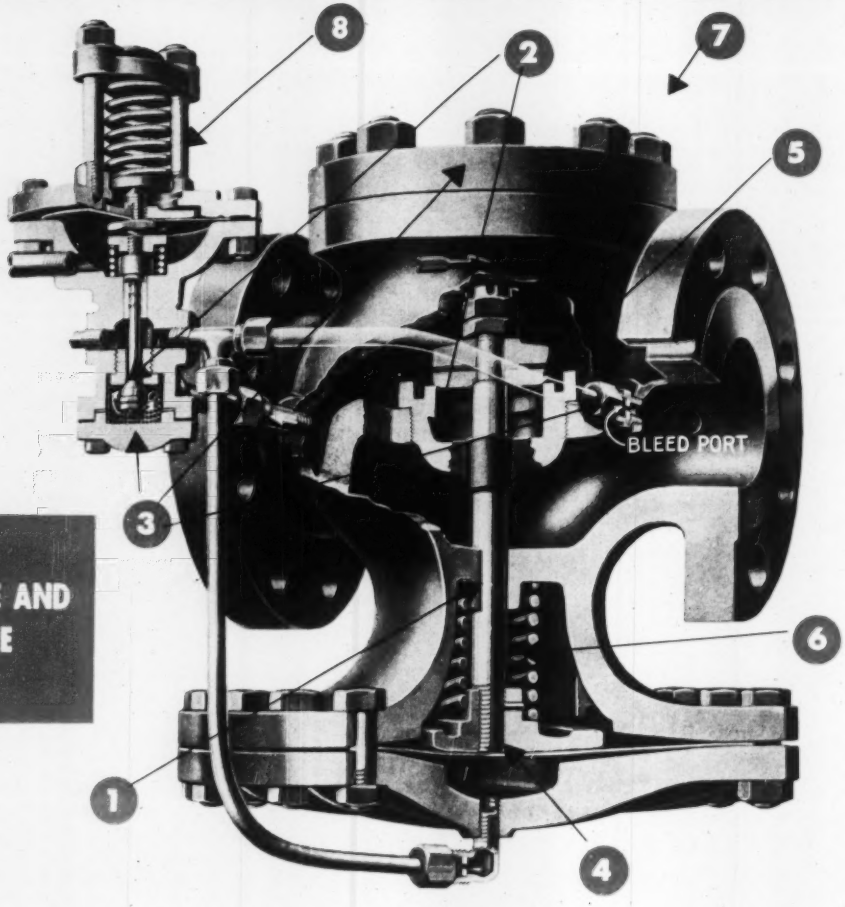
**FULTON SYLPHON**
DIVISION

FIRST WITH BELLOWS

ROBERTSHAW FULTON CONTROLS CO., KNOXVILLE 4, TENN.

*Canadian Representatives, Darling Brothers, Montreal*

# THESE SPENCE FEATURES *Reduce*




**A TYPICAL SPENCE PRESSURE AND TEMPERATURE REGULATOR**

**LESS DOWN-TIME** of the system! Less time and money wasted on replacement of parts! Thousands of installations throughout the country have proved that Spence Self-Operated Regulators stay "on the line" . . . provide *dependable, trouble-free* pressure and temperature control. Users know these precision-engineered Spence units rarely need extensive repairs or special attention. Here are a few of the Spence design features that help keep *maintenance at a minimum:*

1 **PACKLESS CONSTRUCTION**—All Spence main valves and most pilots are built without stuffing boxes. This packless construction saves many maintenance man-hours because it eliminates the need for closely fitted parts which may stick or bind due to uneven expansion or foreign matter.

2 **EASY TO CLEAN**—The seat and disc of the main valve and pilot can be cleaned and any working part removed *without taking the main valve out of the line.*

3 **NO DISMANTLING FOR INSPECTION**—Special openings are provided to inspect the main valve disc, the pilot valve member and the SECO Metal bleedport. Inspection is easier, too, because the pilot is not an integral part of the main valve. The pilot is protected by an accessible built-in strainer.

4 **LONG-LIFE METAL DIAPHRAGMS**—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

# SPENCE PRESSURE *and* TEMPERATURE

# Maintenance...Cut Costs

## BUILT TO LAST FOR YEARS!

**That's the reason Spence Self-Operated Regulators lower over-all costs. Dollar for dollar, you can count on quality performance for a longer period of time. Look at three of many Spence features that assure long regulator life:**

**5 DURABLE SECO METAL SEATS AND DISCS**—Spence seats and discs are made of durable SECO Metal which resists wiredrawing. *More than twenty years of experience* with SECO Metal in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

**6 SPRING OUT OF PATH OF STEAM**—The spring in the Spence Regulator is out of the path of high-pressure steam or other fluids flowing through the valve. Since the spring operates at low unit stress, it has exceptionally long life.

**7 LESS FRICTION**—All Spence Regulators are built with *packless* main valves which are actuated by large, balanced diaphragms. This design minimizes friction. Valves remain unaffected by changes in service conditions or length of service.

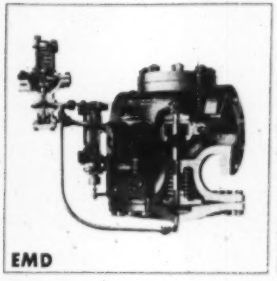
### WHY SPENCE UNITS REGULATE ACCURATELY

**8 YOU CAN BE SURE** of accurate regulation because *sensitive* pressure or temperature pilots control the main valve of every Spence unit. This unique design enables the Spence Regulator to serve many functions and handle all the various types of fluids under a wide range of conditions.

One of the great advantages of this Spence design is the interchangeability of all pilots on all sizes of main valves. Any main valve can be changed from a pressure to a temperature regulator or vice versa *simply by substituting one type of pilot for another.*

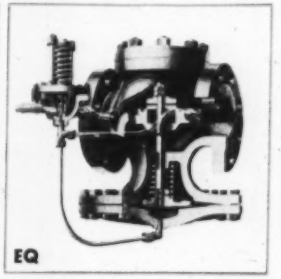
### WIDE RANGE OF SIZES

Spence Regulators are built in sizes from *¼" to 12"* for service with *air, steam, water, oil or gas.* With minor adjustments, any Spence Regulator can be easily switched from one service to another.



EMD

E2T100

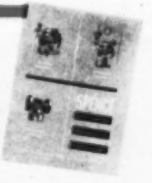


EQ

The Type **EMD** Pressure Regulator includes a SPENCE Solenoid Pilot to cut it on and off electrically • The Type **E2T100** Temperature Regulator in effect is a pressure regulator which is constantly reset by small variations in temperature at the sensitive thermostat. • The Type **EQ** Back Pressure Regulator is a self-operated, packless unit which controls its own initial pressure. The general construction is the same as the Type ED Pressure Regulator.

### *FREE BULLETIN GIVES ALL THE FACTS*

YOU WILL FIND complete engineering details and selection data on Spence Regulators in free bulletin No. 5000. It features a *full color, fully illustrated description of the operating cycle* of a Spence Regulator. Send for your copy of this valuable bulletin today.



**SPENCE ENGINEERING COMPANY, INC.**
**WALDEN, NEW YORK**

PARTIAL LIST OF USERS

- The Cleveland-Cliffs Iron Company
- Tennessee Coal, Iron and Railroad Company
- The Springs Cotton Mills
- Ford Motor Company
- Cochrane Corporation
- Philadelphia Electric Company
- Pennsylvania Power & Light Company
- L. H. Gilmer Company Div. of United States Rubber Co.
- York Corporation
- Jones & Laughlin Steel Corporation
- The Duluth Steam Corporation
- Rochester Gas and Electric Corporation
- Consolidated Gas Electric Light and Power Company of Baltimore
- Phenix Natural Gas Company
- Cutter Laboratories
- National Tube Company
- The Atlantic Refining Company
- Great Lakes Steel Corporation
- Union Electric Company of Missouri
- Todd Shipyards Corporation
- Oxford Miami Paper Company
- Land O'Lakes Creameries, Inc.
- Ohio Edison Company
- General Electric Company
- R. J. Reynolds Tobacco Company

**REGULATORS**

**Spence**

# DUST-STOP* Now Cuts Air Filtering Costs Even More

The reason: DUST-STOPS now have *one-third* longer life—with the same high efficiency as before!

And DUST-STOPS are listed by the Underwriters' Laboratories, Inc. for fire-safety. That may mean even lower insurance rates—to you!

For full information, write Owens-Corning Fiberglas Corporation, Dept. 40-E Toledo 1, Ohio.

DUST-STOP*

*T. M. REG. U. S. PAT. OFF.

AIR FILTERS

a OWENS-CORNING FIBERGLAS product

*DUST-STOP and FIBERGLAS (Reg. U. S. Pat. Off.) are trade-marks of Owens-Corning Fiberglas Corporation for impingement type air filters and a variety of products made of or with glass fibers, respectively.

FIBERGLAS IS IN YOUR LIFE...FOR GOOD!

**A GROUNDED 200 hp motor recently put a large press out of commission for a midwest steel-tank firm. Dietz Electric, A-C Certified Service Shop, picked up the motor Saturday a.m. The stator was rewound and the motor back on the press in 36 hours — with no lost production time!**

GET, FAST, RELIABLE SERVICE like this wherever your plant is located from your nearest A-C Certified Service Shop. There are 80 of these shops in every major industrial area in the U. S.

These independent shops are hand-picked for fine workmanship, high business standards, and excellent facilities. Their work meets factory-established standards.

When you need new motors — or matching control — call your nearest A-C Certified Service Shop or Authorized Dealer. A-3067

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**COLORADO**
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Hartford—Charles H. Leppert
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**FLORIDA**
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THERE ARE 80
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*Certified Service Shops*
THROUGHOUT THE U.S.A.!

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# TRANE

New Series 50 Evaporative Condenser cuts water consumption to a trickle. For loads 10-100 tons.

## ANNOUNCING A NEW WATER SAVER

Here's a fluid answer to solid regulations restricting the use of water for air conditioning. Sleek, new Trane Evaporative Condensers SAVE WATER and use it over and over again.

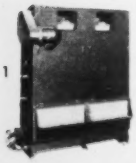
New Series 50 units—rated according to ASRE standards. Quality features include condenser coils made of everlasting copper tubing. Non-ferrous spray trees. Non-clogging nozzles. Hot-dip galvanized fan wheels and scrolls. Extra heavy shafts permit two-bearing, self-aligning assembly. Sturdily constructed for either indoor or outdoor installation.

See data Bulletin DS-350 for details on the complete line of Trane Evaporative Condensers.

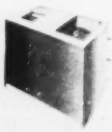
**THE TRANE COMPANY . . . LA CROSSE, WIS.**

EASTERN MANUFACTURING DIVISION, SCRANTON, PA.

Manufacturing Engineers of Heating, Ventilating and Air Conditioning Equipment—Unit Heaters, Convector-radiators, Heating and Cooling Coils, Fans, Compressors, Air Conditioners, Unit Ventilators, Special Heat Exchange Equipment, Steam and Hot Water Heating Specialties . . . IN CANADA, TRANE COMPANY OF CANADA, LTD., TORONTO.

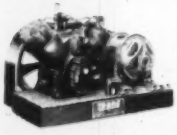


1



2

Versatile design of Series 50 (1) permits either left or right-hand drive. JN Series (2) for loads 3-10 tons. For complete air conditioning system specify Trane Compressors (3) and Climate Changers (4).



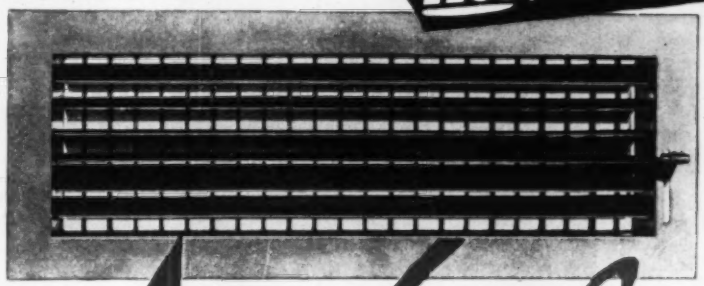
3

4

# MAKES ANY AIR CONDITIONING SYSTEM A BETTER AIR CONDITIONING SYSTEM

Yet It COSTS LESS.....

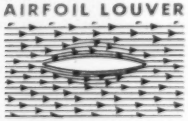
● *Illustrated below—*
#276 4-way multi-shutter register . . . features front louvers and rear damper blades parallel to long dimension . . . second row louvers parallel to short dimension.



# Air Foil

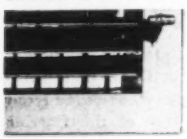
## 4-WAY MULTI-SHUTTER REGISTER

SOLID-SECTION AIRFOIL LOUVER



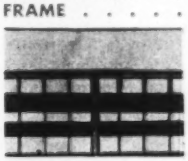
● Louver knifes air in wind tunnel tests. Turbulence has been almost eliminated giving noiseless control of air.

LEVER CONTROL



● Inconspicuous lever in face of frame controls dampers for complete shut-off.

EXTRA-STRENGTH FRAME . . . . .



● New, exclusive Titus concealed support eliminates unsightly mullions and butted construction.

The smartly designed #276 combines *4-way #270 grille* with the *multi-shutter damper* to assure maximum directional control with positive volume control and shut-off. Damper blades interlock for complete shut-off.

The two front sets of louvers are individually adjustable with blades on ¾ inch centers.

Dampers are controlled from face of grille by inconspicuous lever. Removable lever furnished at no extra cost.

### EXTRA STRENGTH—LONGER LIFE

Sound, inspired know-how engineering gives the #276 superb simplicity of design with no unnecessary parts—no clumsy bulk. A special patented, *concealed support* eliminates unsightly mullions and butted construction permitting superior strength with no added weight.

### EASY TO INSTALL

#276 grilles are light in weight—easy to carry—easy to fit—easy to put in place. *Save much costly time and labor.*

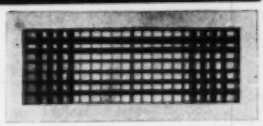
### EXTRA VALUE AT LOWER COST

AIRFOIL grilles are priced down to give you more value—more performance—more efficiency—at less cost.

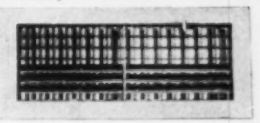
### NOTE THESE OUTSTANDING AIRFOIL FEATURES . . .

- Smooth-as-glass AIRFOIL louvers.
- Extra-heavy frames.
- Airtight rubber gasket.
- Positive shut-off.
- Individual louver adjustment.
- Removable lever.

## LOOK TO AIRFOIL FOR THE FINEST

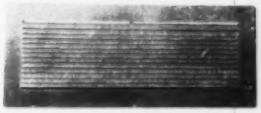


**L-270** 4-way directional grille for complete control of air stream.

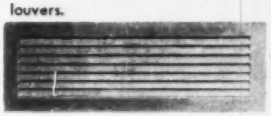


**L-274** Double directional grille with multi-shutter damper.

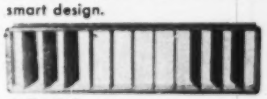
**S-8** 4-way grille with louvers on ½" spaced front.



**RL-21** Return air grille of fixed deflection type with closely spaced louvers.



**RL-230** Return air grille incorporates rugged construction and smart design.



**AG-25** Volume controller designed to fit behind grille.

CHECK TYPE OF GRILLE ON WHICH INFORMATION IS DESIRED

- ☐ Air conditioning outlets
- ☐ Return air grilles and registers
- ☐ Volume controllers
- ☐ Perforated metal and ornamental grilles
- ☐ Door ventilators
- ☐ Special made-to-order grilles

TITUS MANUFACTURING CORP., WATERLOO, IOWA

_____ Rush information on #276.
_____ Send complete catalog.
_____ Send literature on above checked items.

NAME _____

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# Throw it back!

This is a fish? Fish don't walk! Throw it back!

Whatever it is, it illustrates our story. There are no freaks in a Carrier system. And no "weak links" either. For air conditioning, refrigeration or heating that you can depend on—depend on Carrier all the way.

Your customers will get a better job if you see that it's completely Carrier. And if you supply genuine Carrier equipment all the way through, it will go right on being a better job.

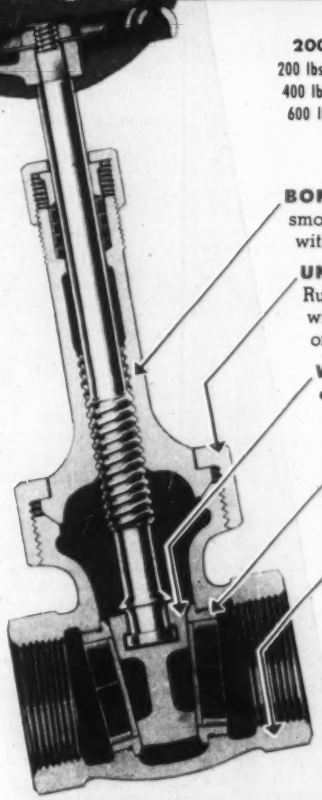
It makes sense, doesn't it? Follow it and nobody will ever say about one of your installations, "Throw it back!"

To satisfy customers, just remember that every significant advance in air conditioning in the last half century has come from Carrier. These are a few of the Carrier products available: Conduit and Duct-type Weathermaster systems for the multi-room building; Evaporative Condensers; Central Air Conditioners; Dehumidifiers; Self-contained Air Conditioners; Reciprocating, Centrifugal and Absorption Refrigeration Machines; Cold Diffusers and Heat Diffusers. Carrier Corporation, Syracuse, N. Y.

**Carrier** AIR CONDITIONING • REFRIGERATION • INDUSTRIAL HEATING

## ASK YOUR R·P&C DISTRIBUTOR ABOUT

# R·P&C UNION BONNET BRONZE GATE VALVES



| 200 LB. CLASS | 300 LB. CLASS |
|---|---|
| 200 lbs. steam at 500°F. | 300 lbs. steam at 550°F. |
| 400 lbs. OWG (non-shock) | 600 lbs. OWG (non-shock) |
| 600 lbs. Hydrostatic Test | 800 lbs. Hydrostatic Test |

**Integral Bronze Seats**
**Nickel Bronze Seat Rings**

**BONNET** P & C High Test Bronze with smoothly machined bevel for tight joint with body.

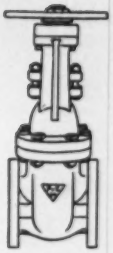
**UNION RINGS** P & C Valve Bronze. Rugged. Permits repeated disassembly without distortion of body or weakening of threads.

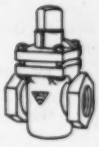
**WEDGE** Nickel alloy. Reversible. Milled grooves engage guide ribs in body, reducing seat wear. With valve full open, wedge clears line of flow.

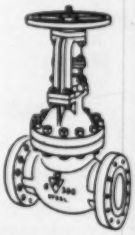
**SEAT RINGS** Nickel alloy (renewable in sizes 1" and larger) or bronze, integral with body.

**BODY** P & C High Test Bronze. Heavy end hexes. Heavy section and strong threads at union for long service.

● *Send*
*FOR YOUR COPY OF DH 191*







ACCO

Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

READING-PRATT & CADY VALVES

# THE FISHER "WORKHORSE" FOR STEAM PRESSURE REDUCTION

## BUILT FOR UNFAILING SERVICE

**Power engineers everywhere have ok'd the Fisher Type 92 for steam pressure control! It's an accurate, compact, flexible, sturdy controller, designed, built and proved to meet the most exacting requirements for steam service.**

# TYPE 92A

*PILOT OPERATED CONTROL VALVE*

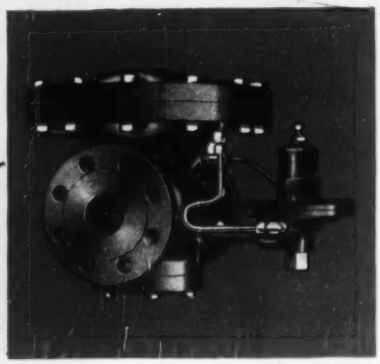
**SINGLE SEATED • TIGHT CLOSURE**

The single seated construction assures tight closure and prevents excessive pressure build-up. Reduced pressure ranges 3-200 PSI. Inlet pressure up to 250 PSI at 450°F.

Fisher Bulletin C-2A gives full details. Write for your copy today.

**Fisher Governor Company**

Marshalltown, Iowa



**ACCURATE**

Pilot control — with its extreme sensitivity to flow changes — maintains the desired reduced pressure with remarkable accuracy. No auxiliary pilot operating medium is needed.

**COMPACT**

Modern Fisher Engineering has produced in the Type 92 Valve a compact controller with unusually large capacity. Available in 10 sizes from ½" to 2" screwed or 1" to 6" flanged. No special wrenches are required for servicing.

**FLEXIBLE**

Two pilot assemblies for high or low pressure service are available and interchangeable on all Type 92 sizes. Pilot control spring easily adjusted or changed to obtain a variety of reduced pressure ranges.

**STURDY**

High-tensile bodies and diaphragm casings are of extremely rugged, ribbed construction. Inner parts are of Duromite bronze or stainless steel—or special material as ordered. Every construction detail designed to assure maximum trouble-free service.

THE MARLEY COMPANY, INC.

# Which is Better?

## SERIES 200 - VAIRFLO

## Natural or Mechanical Draft

IT'S all the application—they're both the best of their type in quality and in price. Let your Marley Application Engineer show you how to get the best one for your specific job. He will show you how to evaluate first costs — operating cost — wet bulb requirement — driftage — horsepower—pumping costs—wind velocity—fire codes, and many other important factors. Mechanical Draft or Natural Draft—Marley VAIRFLO or Marley Series 200 —you know you are getting the most for your dollar.

VAIRFLO . . . a Mechanical Draft tower from 40 to 750 tons of refrigeration that includes many extra quality, heavy duty features formerly found only on large, industrial cooling towers. Because they are mass produced, these extra quality features are standard on the Vairflo at no extra cost. These features include totally enclosed motor, lifetime nail-less filling, Marley designed cooling tower fan, grease packed enclosed bearing housing, balanced spray nozzle distribution system, extra heavy framing and bracing, complete basin fixtures, available in redwood or steel or with an asbestos-board casing. Bulletin V-50.

Series 200 . . . a Natural Draft cooling tower COMPLETELY PREFABRICATED and piece marked with full erecting, operating and maintenance instructions. Made from heart quality surfaced redwood. Has Marley nozzles in a balanced spray system, machined louver posts, slip-fit louvers, complete basin fixtures, including sump and float valve, and is braced with heavy diagonals. Bulletin 200-50.

Take advantage of the Marley man's "know-how." Let him analyze your water cooling problem and make a good sound recommendation. He will be glad to help you at no cost or obligation.

**MAIL THIS COUPON TODAY**

The Marley Company, Inc., Kansas City 15, Kansas

- ☐ Bulletin V-50 ☐ Bulletin 200-50
- ☐ Please send FREE copy of "What's Your Cooling Tower I. Q.?" Illustrated folders available on Cooling Tower Operation, Maintenance, Water Treatment, Testing, Specifications.
- ☐ Have Marley Application Engineer call.

HP-5

Name _____ Title _____

Company Name _____

Address _____

City _____ Zone _____ State _____

MARLEY

Double-Flow Vairflo DriCooler Natural Draft Counter-Flow Aquatower Spray Nozzles

**ONLY THE SPORLAN CATCH-ALL FILTER-DRIER**

*offers you* ***both***

**GREATEST FILTERING AREA**

**HIGHEST DEGREE OF ACTIVATION**

SPORLAN

Size for size, the Sporlan Catch-All with its scientifically molded porous cylinder offers the greatest filtering area because its end surface is augmented by its complete cylindrical surface into a tri-dimensional filtering area, filtering out any foreign matter as minute as 9 microns with negligible pressure drop!

Sporlan Catch-Alls are activated to the highest degree of dryness after they are completely assembled by subjecting them to a temperature of over 500° F. for a minimum of four hours! The Sporlan Catch-Alls are then sealed with moisture proof seals to prevent any loss of activation before installation.

*When you want perfectly clean, perfectly dry refrigeration systems . . . install*

**SPORLAN *Catch-Alls***

*the perfect filter-driers and* GET PEAK PERFORMANCE ON ALL INSTALLATIONS

*Catch-Alls are available in all sizes at all Sporlan wholesalers*

***AND HERE ARE 5 ADDITIONAL EXCLUSIVE CATCH-ALL FEATURES***

1. They cannot powder!
2. They cannot pack!
3. The refrigerant cannot channel around the desiccant!
4. The unique, porous Catch-All cylinders are molded of minute particles of a highly efficient desiccant, the efficiency of which is greater than that of the same desiccant in granular form.
5. They dry down to a low end point . . . a point so low that any remaining moisture is absolutely harmless!

# SPORLAN

**VALVE COMPANY**

**7525 SUSSEX AVENUE • • • ST. LOUIS 17, MISSOURI**

# HIGHER TEMPERATURES • HIGHER PRESSURES

## SIZE-FOR-SIZE, *AT NO EXTRA COST*

# *New* FORGED STEEL VALVE

OIC SETS THE PACE IN VALVES

Here's the answer to your toughest pressure-temperature problems! It's the brand-new OIC Figure 1221, designed to take *higher* pressures, higher temperatures, tougher all-around operating conditions — with *no* increase in cost over its most popular competitors. It gives you a bonus of safety on your standard applications, and you needn't "step up" to more expensive valves to meet extra-high job ratings. You can *standardize* on the complete OIC forged steel line. You're in for a pleasant surprise when you check specifications of the new forged steel series, so don't wait. Call your nearest OIC distributor. *See this valve now!*

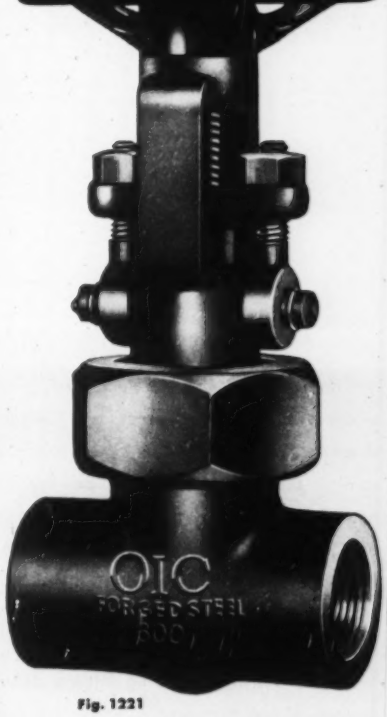



Fig. 1221

**FIGURE 1221,** shown right, comes in two standard trims—CH for oil or oil vapor at temperatures to 1000°F.;

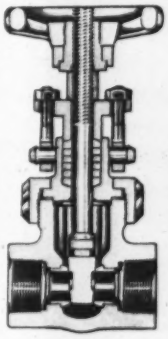
**HCH** for steam and other non-lubricating fluids to 850°F.

**FORGED BODY,** with wedge-guide machined in true relationship with bonnet joint for perfect alignment. Seat rings, of 13 Chrome stainless steel sealed tightly against body, keep out corrosive liquids, cut chemical action.

**STEM,** of 13 Chrome stainless steel, mates with a back-seating surface on bonnet, so valve can be repacked under full pressure. Wedge is a one-piece forging of 13 Chrome or hardened stainless steel, depending on trim.

**OS&Y** construction protects stem-threads from fluids and hot internal temperatures. Easy lubrication.

**ALL METAL SECTIONS** are extra-heavy to *exceed* recognized construction codes. Grain-pattern of forgings adds strength, provides safety, reduces wear.



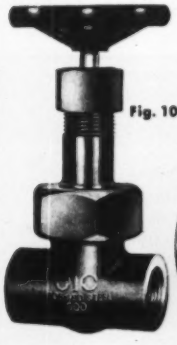


Fig. 1021

Fig. 1320

**THERE ARE 262 DIFFERENT VALVES** in the OIC forged steel line. It's the *longest* line ever presented to the trade at one time. Shown at left are two more gate valves—inside screw, Fig. 1021, and flanged end, bolted bonnet, Fig. 1320. But whether you need gates, globes, angles, or checks, be sure to investigate the *complete* OIC forged steel series. Write immediately for free descriptive material.

OIC

# VALVES

FORGED STEEL • IRON
CAST STEEL • BRONZE

THE OHIO INJECTOR COMPANY
243 MAIN ST. WADSWORTH, OHIO

9-450-S

# VARIETY

is not the spice of life here but it

## Permits Piping Improvement

Midwest offers a large variety of welding fittings to help *you* improve *your* piping. Many of these fittings were originated by Midwest for the purpose.

For example, the Midwest Reducing Elbow saves a third of the welding, decreases turbulence and pressure drop and improves appearance when used instead of a standard elbow and reducer. Midwest Long Tangent Elbows have a tangent or straight section at each end equal to ¼ the nominal pipe size; this saves pipe, saves time in lining up, and often saves welding. (These are in addition to ASA Type and Short Radius Elbows.) Midwest Sleeves relieve the line butt weld of all bending stress and much of the tensile stress. Midwest Saddles restore the original pipe strength and reinforce the joint.

Use of Midwest Welding Fittings assures maximum improvement and economy in piping. For your welding fitting needs, get in touch with the Midwest Distributor near you.

MIDWEST

**PIPING & SUPPLY COMPANY, Inc.**

**MAIN OFFICES: 1450 SO. SECOND STREET, ST. LOUIS 4, MO.**

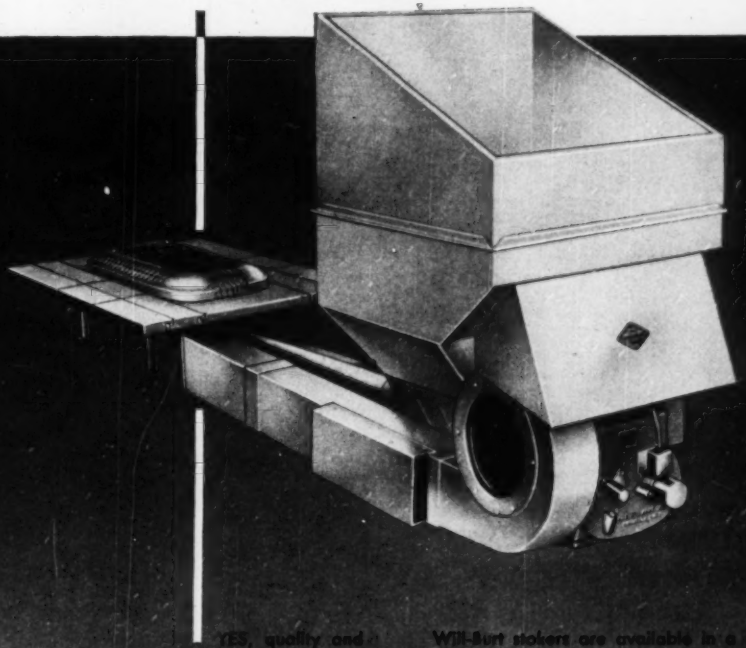
Sales Offices: New York 7—30 Church St. • Chicago 3—79 W. Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—533 Mayo Bldg. • South Boston 27—426 First St.
Stocking Distributors in All Principal Cities

**MIDWEST WELDING FITTINGS**
**Improve Piping Designs and Reduce Costs**

4094

*Quality-wise* means PROFIT-WISE...

that's why WILL-BURT means MORE PROFIT



YES, quality and profit go hand-in-hand—for only by providing products of the highest quality can a heating contractor, dealer or distributor hope to develop the good will which makes his customers recommend him to their friends.

That's why Will-Burt heating folks "stay put"—because the quality of Will-Burt stokers and other heating products keeps customers happy—and because Will-Burt's time-tested dealer policy is friendly, helpful, considerate.

Will-Burt stokers are available in a full range of styles and sizes, in capacities up to 600 pounds per hour. Backed by more than 50 years of manufacturing experience—more than 20 years in designing and manufacturing bituminous coal stokers—a Will-Burt stoker will provide the safe, sure, efficiency you'll need for your next installation.

May we send you more information?

**OTHER WILL-BURT HEATING PRODUCTS**

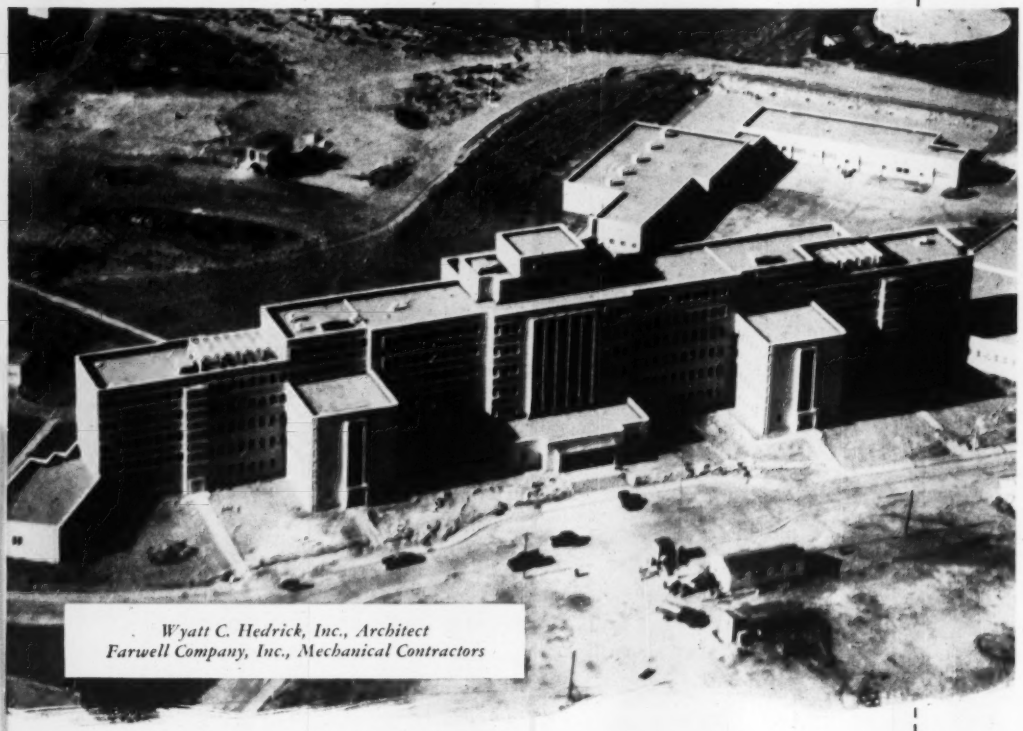
Oil and gas conversion burners.
Residential hot-water heating boilers.
Coal, gas and oil-fired warm-air furnaces.

WILL-BURT

**THE WILL-BURT COMPANY**

DEPARTMENT H ORRVILLE, OHIO

VETERANS HOSPITAL DECLARES WAR ON DUST AND SOOT



*Wyatt C. Hedrick, Inc., Architect*
*Farwell Company, Inc., Mechanical Contractors*

# 3 types of AAF filters serve new Big Springs, Texas unit

IT'S "No Admittance" for dust and soot at the new Veterans Administration Hospital at Big Springs, Texas. All air conditioning units in this building are serviced by AAF filters. In the operating rooms super-clean air is supplied by Electro-Matic* filters. Kitchen and service areas are served by Multi-Duty filters and the seclusion wards by American Type M/W viscous unit filters.

Here again AAF's complete line of product assures the right filter for each air cleaning requirement—an important factor in keeping performance standards high and costs low. AAF has no stock solution for all air cleaning problems. Its line of filters ranges from the simple low cost throway unit to the high efficiency electronic precipitator. As a result, you can fit the filter to the job rather than the job to the filter.

Clean air is rapidly becoming an important commodity in the minds of business and industry. Your local AAF representative will be glad to assist you in the planning of your customers' air cleaning needs. Write today for his name and complete product information.

**AMERICAN AIR FILTER COMPANY, INC.**
373 Central Avenue, Louisville 8, Kentucky
*In Canada: Darling Bros., Ltd., Montreal, P. Q.*

**Automatic Electronic Precipitator*

®AAF

**AIR FILTERS**
**AND ELECTRONIC PRECIPITATORS**

Contractors: W. E. Beggs & Company, Seattle

# EVERDUR tanks for Seattle Veterans' Hospital

*...hospitals must have dependable hot water!*

For a new 340-bed Veterans' Hospital in Seattle, the Western Blower Company fabricated three Everdur* hot water generators ranging from 1000 to 2000 gallons capacity. The inert-gas-shielded arc welding method, using Everdur rod, was employed in construction.

Each year more and more plant and property owners discover the real economy of Everdur Copper-Silicon Alloys for hot water storage heaters. Everdur tanks not only eliminate the periodic, expensive burden of rust-repairs, and eventual replacement due to rust . . . but they also assure lasting freedom from red, rusty hot water.

The wide acceptance of Everdur for heater shells is indicated by its extensive use in the processing industries, and also in laundries, hotels, hospitals, public buildings, industrial and commercial installations, schools and homes.

Everdur is ideal for durable heaters. It is rustless as copper, exceptionally strong and can be readily welded by all the usual methods for the most efficient type of tank construction.

Any questions? Any application or fabricating problems? Write The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

SH64

*Reg. U. S. Pat. Off.

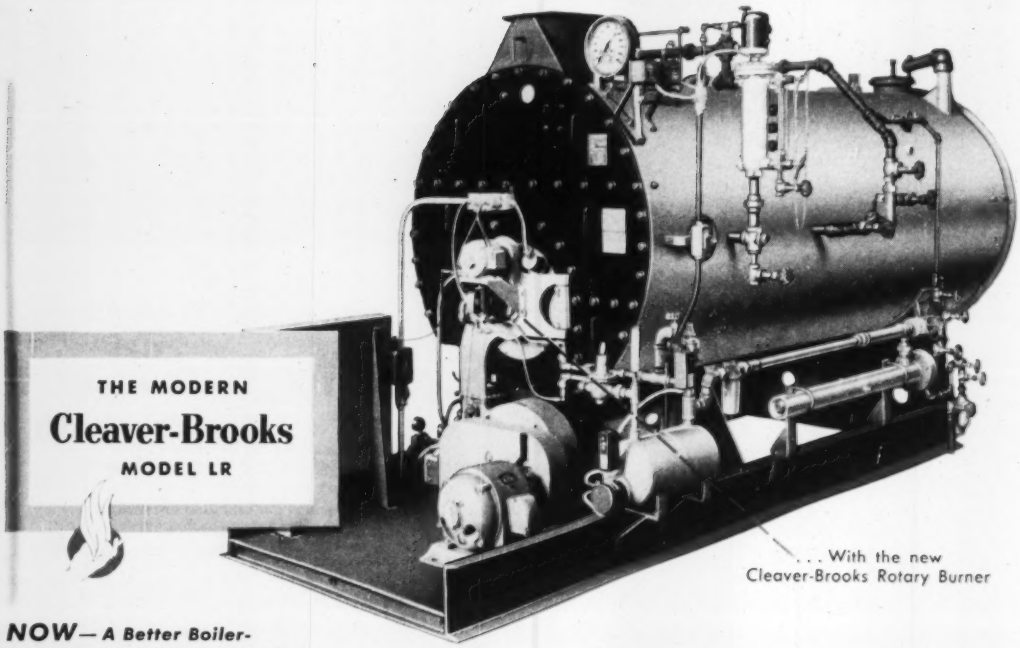
**Where corrosion resistance counts — use Everdur**

ANACONDA®

**COPPER-SILICON ALLOYS**

# Design

## FOR PRODUCING STEAM




***NOW*— *A Better Boiler-Burner Unit to Utilize Today's Low-Cost Fuels — Heavy Oil and Gas***

The Cleaver-Brooks Model LR is a "trail-blazer" in modern self-contained boiler design and construction. It makes more effective use of today's low-cost fuels, (heavy oils and gas), and you are assured of better boiler performance.

*A Brief List of Notable Features:*

— the new Cleaver-Brooks rotary burner — simple — compact — precision machined — perfect mechanical balance — fully automatic — provides unprecedented flexibility in burning heavy fuel oils or industrial gases.

— single low-speed, low-power consumption blower furnishes both primary and secondary air for combustion—less weight and space requirements — reduction in sound levels.

— totally enclosed, drip and dust-proof panel for all major electrical controls.

— electronic combustion safety devices, dual low water cutoffs — are standard equipment.

— simplified design of combination gas-oil burner permits change-over from oil to gas or vice versa in less than a minute.

— improved design of boiler furnace and liberal heating surfaces provide greatest economy with all fuels.

— boilers of all-welded construction — meet standards of A.S.M.E. boiler code and leading underwriters — burner approved by recognized national agencies.

The Cleaver-Brooks Model LR self-contained boilers are of a highly developed four-pass fire tube design — tested and proved by factory and field experience on several thousand boilers of this type.

*Write for complete specifications, dimension data, firing rates.*

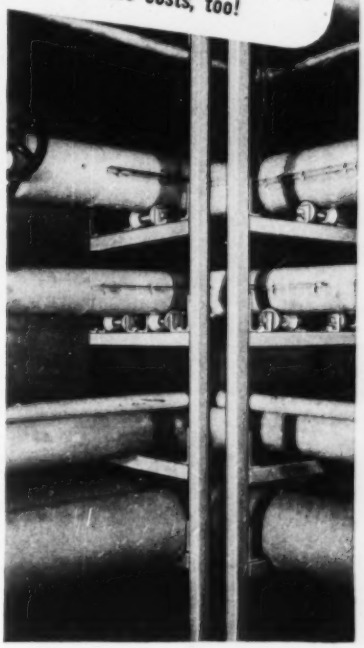
CLEAVER-BROOKS COMPANY
**367 EAST KEEFE AVENUE**
**MILWAUKEE 12, WISCONSIN**

**Now Ready:** Bulletin SG 142 contains detailed data and description of the MODEL LR. Send for your copy today!

# FOR TUNNEL PIPING and EQUIPMENT SUPPORTS use UNISTRUT METAL FRAMING

**Completely adjustable Unistrut provides flexibility you need for right pitch or slope . . . You make adjustments, changes, additions at any time . . . reduce costs, too!**

Unistrut steel channel and fittings, roller pipe supports and concrete inserts at work in a tunnel installation at G. D. Searle & Co., Skokie, Illinois, manufacturers of ethical pharmaceuticals.



● Unistrut consists of patented metal framing, spring nuts, standard parts and fittings, which in combination provide the world's most flexible method of support or suspension.

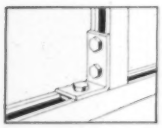
With completely adjustable and reusable Unistrut, normally difficult and complex piping runs may be installed with extreme accuracy, quickly and easily with just a hacksaw and a wrench. No drilling—no welding—no special tools or equipment!

Piping runs can be installed to exactly the right pitch or slope. Adjustments and changes are easily made by the mere loosening of a nut. Additional framing may be added at any time when more piping runs are needed.

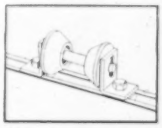
Unistrut is trim framework, providing great strength without bulk. It's easy to work with, lasts indefinitely, and the finished structure assures neat and orderly appearance.

Unistrut cuts costs too. You save time in your engineering department and you eliminate the need for trained erection crews—anyone can build with Unistrut.

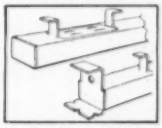
A trial of Unistrut on your next piping job will show you how much quicker, better and more economically the work can be done.



Close-up of patented Unistrut channel members, spring nuts and fittings of a type used in the Searle installation.



Unistrut single axle 2-roller pipe supports as seen in the accompanying photographs. Types available to support from 1" to 36" O.D. pipe.



This Unistrut concrete insert is the type used on the Searle job. 1600 lbs. per foot load capacity. Other sizes and styles available.

***WRITE TODAY FOR FREE SAMPLE OF UNISTRUT AND THE FOLLOWING CATALOGS:***

Prompt delivery from Warehouse Stocks in Principal Cities. Consult your Classified Directory.

U. S. Patent Numbers
2327587 2329815 2345650
2363382 2380379 2405631
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**CATALOG 500—**
24 pages on how to build frames, hangers and supports for electrical, plumbing, heating and air conditioning equipment—right on the job.

**CATALOG 600—**
24 pages on how to build racks of all kinds—pallet, bar stock, pipe, tube, conduit, automotive parts, hardware, furniture, floor covering, stock bin racks, and many others.

UNISTRUT

The World's Most Flexible All-Purpose Metal Framing

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Please send sample of Unistrut and catalogs checked below without obligation.

☐ Catalog 500 ☐ Catalog 600

Name_____

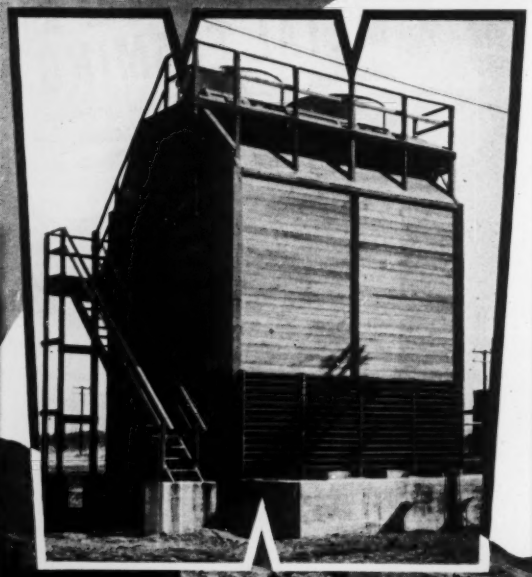
Company_____

Address_____

City_____ Zone____ State____

# WATER'S TOO SCARCE and COSTLY to WASTE

## Save it with a C. H. W. Cooling Tower



Look how much this source of water has dried up! And this is no exception, either. More and more plants are feeling the "pinch" in water supply. Industrial expansion, plus higher domestic use, has overtaxed supply in many areas. Good surface water sources are low and, in areas where there is plenty, the quality is poor and costly to make usable. Although sufficient underground water deposits exist,* it will be several years before they can be tapped. All this means that you'll have to get the most out of what you have, or face production cuts or even a shutdown. But there is something you can do—use a C. H. W. cooling tower for operations requiring cooled water, thus permitting use of the same water over and over again. And you'll find that a C. H. W. cooling tower will not only save water and its cost, but also that cooling performance is guaranteed. For any operation requiring cooled water—chemical, processing, petroleum, air conditioning, etc.—check on a C. H. W. cooling tower first. Write for literature.

*According to Government surveys

**C. H. WHEELER MANUFACTURING CO.**
1826 **Sedgley Ave., Philadelphia 32, Pa.**
REPRESENTATIVES IN MOST PRINCIPAL CITIES

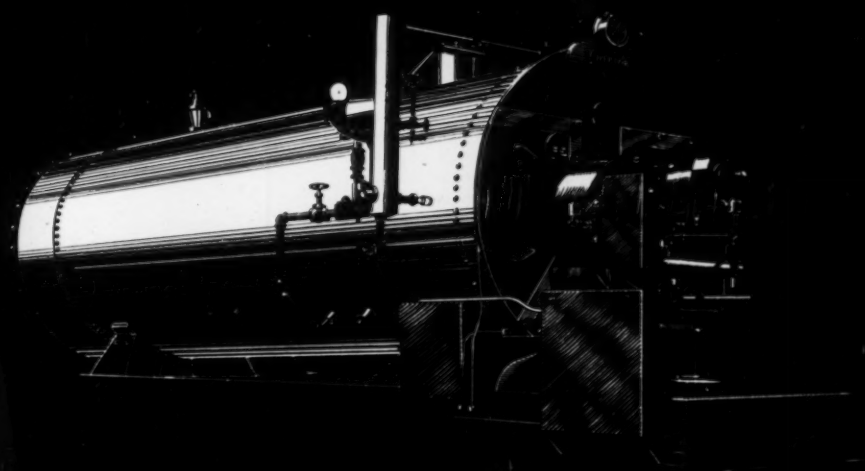
*C. H. Wheeler*
SINCE 1903

DECK MACHINERY · STEAM CONDENSERS
STEAM JET AIR EJECTORS
OF PHILADELPHIA

# FOR THOSE WHO DEMAND

. . . than ordinary steam generator performance, SUPERIOR Steam Generators provide the answer . . . and that "something more" is **more** rugged construction; **more** heating surface, **more** steam area, **more** weight per horsepower; **more** accurate control of fuel and air ratios; **more** dependable combustion equipment; **more** years of operation at peak efficiency . . . all of which adds up to 80% or more thermal efficiency which lasts, and lasts. For a steam generator is a long term investment with high dividends when you buy a . . .

STEAM GENERATOR



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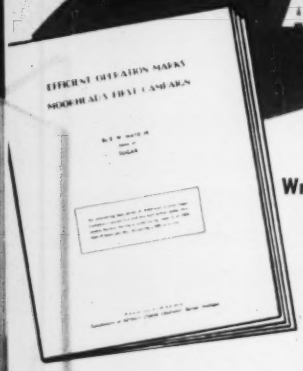
uperior ombustion ndustries, inc.

AMERICAN CRYSTAL SUGAR COMPANY

# ANOTHER FOOD PLANT MAKES SAVINGS WITH DETROIT STOKERS



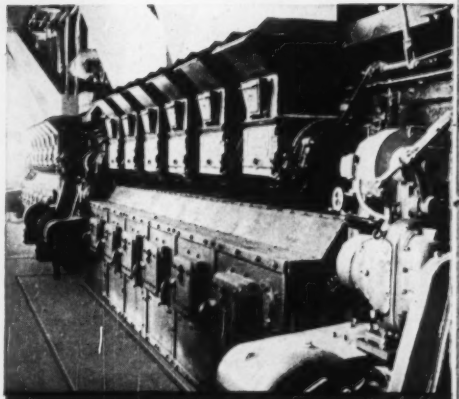

Write for this "Sugar" article

Heat is a major item in food processing. Fuel, therefore, is one of the main expenses. Coal, the "Basic Fuel," burned with Detroit Stokers is the Most Economical Method of Producing Heat. That's why leading Food Plants use them.

American Crystal Sugar Company uses ten Detroit Stokers in three Plants.

For their Moorhead, Minnesota Plant, they selected Detroit RotoGrates for two 110,000 pound steam generating units to process up to 3,000 tons of sugar beets a day.

An important factor in their decision was the necessity of being able to provide dependable steaming capacity with either 13,500 Btu Eastern Bituminous Coal or 6,800 Btu North Dakota Lignite, and to change readily from one fuel to the other if desired. The Lignite, burned has 29% moisture and 38% volatile.

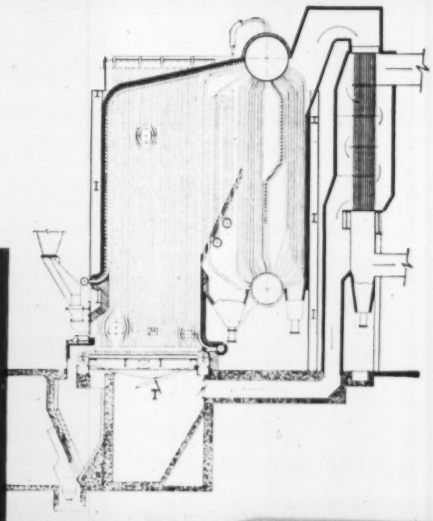


## Popular With Engineers

Cleanliness of Detroit RotoGrate firing combined with ability to handle fluctuating loads also appeals to Food Product Engineers.

You, too, can benefit by these operating advantages. Investigate now—no obligation.

*WRITE FOR CATALOG TODAY*



**DETROIT STOKER COMPANY**

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

*OTHER TYPES AND SIZES OF DETROIT STOKERS FOR EVERY INDUSTRIAL OR POWER NEED*

# Two Valves In One!

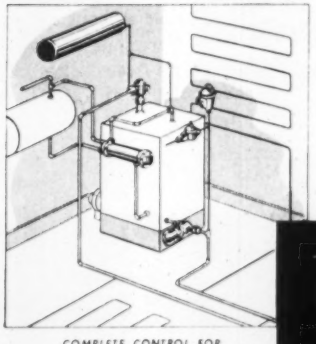
Brass vent tube separates air rising from boiler water. Air passes up outside of tube and vents into pressure tank automatically. Water passes up inside tube.

**THRUSH**

**forced circulating**

**HOT WATER**

**RADIANT HEAT**



COMPLETE CONTROL FOR AUTOMATIC HOT WATER HEAT

**THRUSH FLOW CONTROL VALVE**

## *Controls Flow*

## AND ELIMINATES AIR

**FROM HOT WATER HEATING SYSTEM**

THE NEW IMPROVED Thrush Flow Control Valve is really two valves for the price of one because it provides both flow control and air elimination without any extra "air-tube" fitting. It also takes the place of an elbow in the flow riser. No other flow control valve has all these outstanding value features. Get the facts now.

Highest boiler temperature occurs when the Flow Control Valve is closed. Air and gases which are liberated as the water is heated, vent directly into the pressure tank. Water which passes into the flow main, is always free of air. Result—greater heating efficiency—more uniform heat. You save material cost, save installation time, and reduce inventory requirements by specifying Thrush "T" Flow Control Valves. (They are also available without tube.) Ask your wholesaler for more information today or write Dept. E-5.

**H. A. THRUSH AND COMPANY**

**PERU, INDIANA**

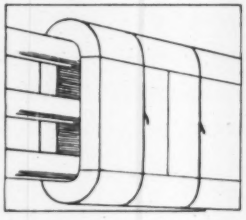
*MANUFACTURER OF HOT WATER HEATING EQUIPMENT FOR MORE THAN A QUARTER CENTURY*

# What's wrong with this picture?

This man is insulating these exposed water tubes the hard way. He's covering each tube separately, instead of insulating the group as a single unit. When boiler tubes, or any other group of hot lines, operate at the same temperatures and are as close together as these, it takes less time and less material to insulate them as one unit. This method is shown in the small illustration below. It also cuts down the area of exposed insulation surface, thus reducing the amount of heat lost by radiation.

Half sections of pipe covering are used on the outside lines, then all lines are boxed in together with insulating block. Of course, if the lines are spaced too far apart, or if they must be readily accessible for maintenance, each line should be insulated separately.

Sometimes whether to insulate piping singly or as a unit may be a pretty close decision. At other times, the answer may be obvious. But there is always one best way of doing this job, just as there is for every other phase of heat insulation work.



In cases like this, Armstrong engineers are trained to recommend the least expensive and most efficient methods. The complete contracting service they represent also supplies you with top-quality insulation materials and sundries, applied by skilled Armstrong installation crews.

If you consult an Armstrong engineer the next time you plan a heat insulation job, his advice may save you time and money. His services are always available without obligation. Call the Armstrong office nearest you or write to Armstrong Cork Company, 4405 Maple Ave., Lancaster, Pa.

## ARMSTRONG'S INDUSTRIAL INSULATIONS

**MATERIALS - INSTALLATION**

**FOR ALL TEMPERATURES FROM 300° F. BELOW ZERO TO 2800° F.**

*From the*

# GREAT LAKES

*Gimbel Brothers Department Store*
*Milwaukee, Wisconsin*

*To the*

# RIO GRANDE

*St. Thomas High School*
*Houston, Texas*

*Architect & Consulting Engineer*
*Maurice J. Sullivan*
*Houston, Texas*

## VARI-VAC DIFFERENTIAL HEATING

### *cuts fuel costs up to 40%*

***Provides unsurpassed comfort year 'round . . . in any climate.*** Whether you are buying for a building in the North or the South . . . a multi-storied structure or a sprawling 2400-family housing project . . . Dunham Vari-Vac* Differential Heating can *cut your customer's fuel costs up to 40%.*

How? By utilizing a continuous flow of subatmospheric steam at temperatures that vary automatically with the outside weather. This heating system with its precision temperature control system has proved so successful in installations all over the country that Dunham has even *guaranteed—in writing*—fuel reductions of 25% for many buildings.

***Job-scaled to your size***

This remarkably economical system is adaptable to any type of structure . . . any size . . . to fit any budget. Seven different systems are available. There's one to fit every need.

Don't overlook this *guaranteed* way to slash your customer's operating costs by keeping heat supply and demand in perfect balance at all times. It will pay you to investigate Dunham Vari-Vac . . . regardless of the type of building you are working on.

***FREE BOOKLET TELLS THE STORY***

Bulletin 509 gives you complete information about Dunham "Job-scaled" Vari-Vac Heating; tells you what it is, how it operates, how it may be fitted exactly to your needs.

C. A. Dunham Co., 400 W. Madison St., Chicago 6, Ill.
*In Canada:* C. A. Dunham Co., Ltd., Toronto
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**Variable Vacuum*

**CONVECTOR RADIATION, BASEBOARD RADIATION,**

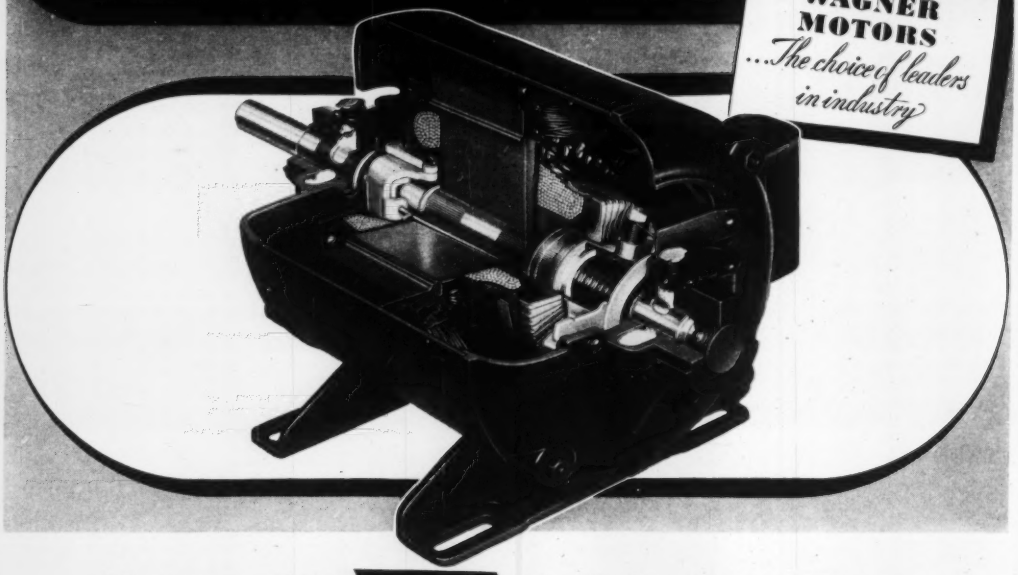
**UNIT HEATERS, TRAPS, VALVES, PUMPS**

**DUNHAM**

HEATING MEANS BETTER HEATING

# YOU CAN IMPROVE THE PERFORMANCE OF YOUR PRODUCT

**WAGNER MOTORS**
*...The choice of leaders in industry*



## Choose this Wagner Two-in-One Motor

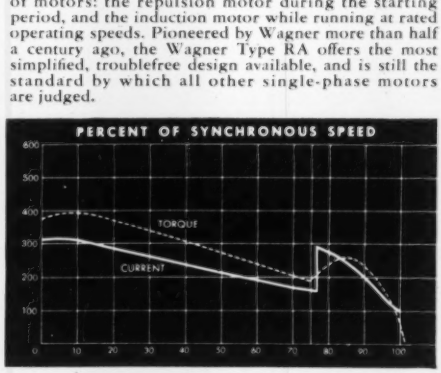
The selection of the *right* motor to power your product is all important. Troublefree operation, dependable long life performance, the ability of the motor manufacturer to provide on-the-spot service when needed, and the reputation of the manufacturer are all factors that build *real* customer satisfaction.

The versatile Wagner Type RA repulsion-start induction motor is not only the *best* choice for practically every type of motor-driven appliance and machine utilizing single-phase current, but is practically the *only* choice for a wide variety of applications because of its low upkeep cost, minimum servicing, freedom from vibration and noise, and years of reliable service.

More than 450 Wagner Authorized Service Branches and Parts Distributors *plus* 25 Wagner-owned Service Branches provide on-the-spot service, genuine repair parts, or service exchange motors.

The graph at right shows the performance curves of the Wagner Type RA Motor. The motor starts as a repulsion motor with high torque but low current and switches to an induction motor while approaching rated speed to assure a constant high operating speed, even under overload, and a flat efficiency curve over a wide operating range.

The Wagner single-phase repulsion-start induction motor is widely known as industry's "general purpose" motor because it combines the best features of two types of motors: the repulsion motor during the starting period, and the induction motor while running at rated operating speeds. Pioneered by Wagner more than half a century ago, the Wagner Type RA offers the most simplified, troublefree design available, and is still the standard by which all other single-phase motors are judged.




Wagner Electric Corporation
EST. 1891

**WAGNER ELECTRIC CORPORATION**
**6370 Plymouth Ave., St. Louis 14, Mo., U.S.A.**

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

**BRANCHES IN 31 PRINCIPAL CITIES**

M50-15

JOHN ZINK

# CENTRAL GAS HEATER Can be installed anywhere . . . . . .

## TWO STYLES

Here is truly a universal, efficient, simple, and compact CENTRAL HEATING UNIT. Fully automatic, it is a complete packaged unit ready for installation. The two heaters shown are almost identical in operation and design of the heat exchanger. The two different types of casings are furnished to meet requirements for a particular application.

Heaters may be installed in the basement, attic, service closet, or utility room of a home. The AF-110 may be installed even under the house if certain provisions are made for the draft diverter. For industrial applications, it may be installed on a shelf or balcony; as a suspended heater and as a duct heater.

Each John Zink Central Gas Heater is equipped with an automatic safety shut-off that is really automatic.

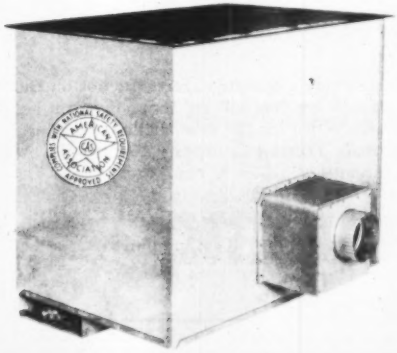
The John Zink Central Gas Heater is designed as a winter air conditioner with a summer switch to provide air circulation during warm weather.

## Gas Fired FLOOR FURNACES

*4 Size for Every Home Heating Requirement*

**Small Floor Grille • Fool Proof • Simple to Operate**

**AGA Approved • Sturdy Construction**



**SIZES**

30,000 Btu input
35,000 Btu input
50,000 Btu input
50,000 Btu input (Conventional)
85,000 Btu input (Conventional)

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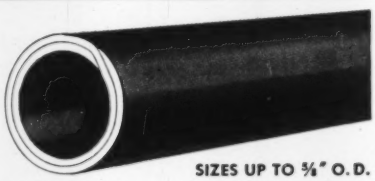

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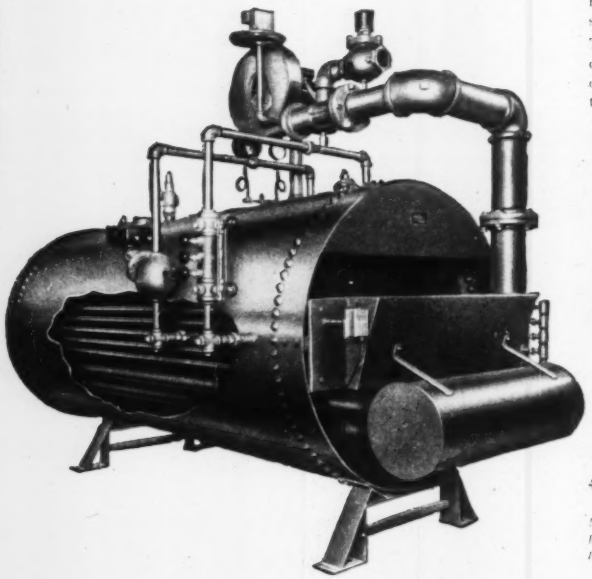

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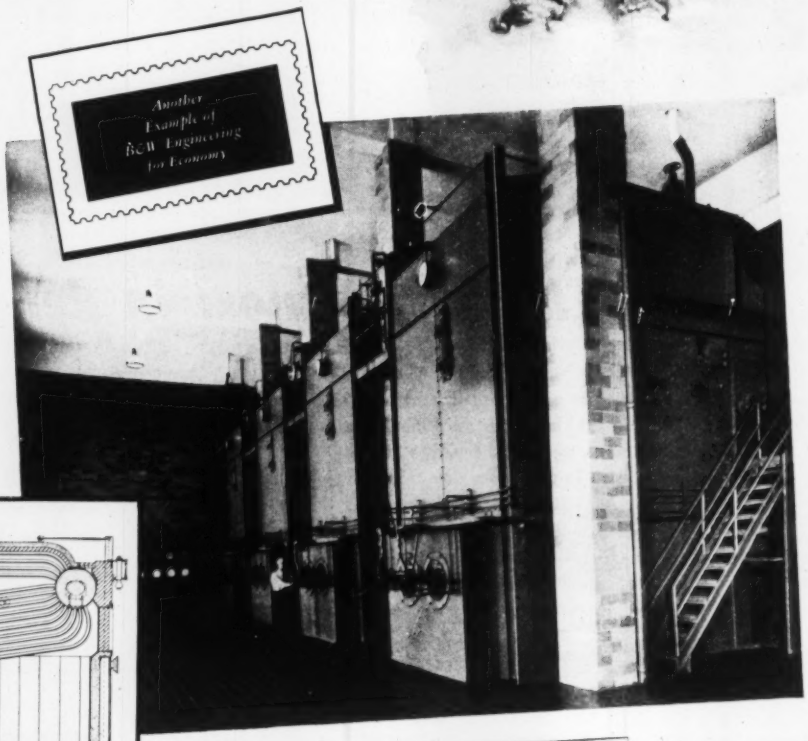
*"He ain't heavy, Father . . . he's m' brother"*

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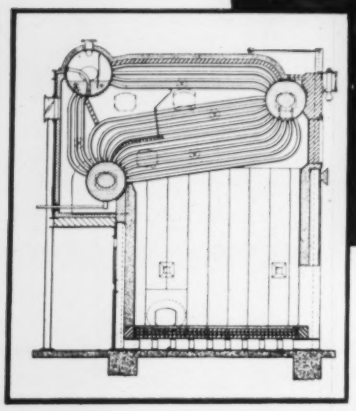


BABCOCK & WILCOX

G-447

# THE EDITOR'S PAGES

## THINGS THAT ALWAYS PUZZLE US . . .

. . . Who can sit in the back of the room (or even half-way back) and read the lettering on the slides shown on the screen at so many engineering meetings?

. . . Why will a speaker—an authority on his subject, and with lots to say about it—hide his head in his manuscript and read it through to the bitter end?

. . . What good do we think we're doing about the situation by printing these ill-tempered remarks?

## CONSTRUCTION VOLUME HITS ALL-TIME HIGH

SETTING A NEW all-time high for monthly construction volume, the March total of building and engineering contracts awarded in the 37 states east of the Rocky Mountains, was $1,300,201,000, according to F. W. Dodge Corp. The former high record figure was $1,190,264,000 reached in June of wartime 1942. The March total was 67 percent ahead of the preceding month and 74 percent greater than the March 1949 total.

A new first quarter record was established this year, exceeding all previous first quarter totals in both dollar volume and physical volume. During the three months of this year contracts were awarded for building and heavy engineering works for the total of $2,810,586,000 and providing for 245,207,000 sq ft of new building space. The quarter's total surpassed the previous record dollar volume of $1,986,936,000 for the corresponding period of last year and the 220,654,000 sq ft total, the previous floor space record set in the first quarter of 1928. The three months total contract awards was 56 percent ahead of last year's corresponding total.

Residential operations, aggregating $1,279,634,000 showed the largest first quarter increase, more than doubling last year's total. Nonresidential projects, which totaled $1,001,519,000, were 30 percent ahead of last year while heavy engineering rose 25 percent to $529,433,000 this year.

Comparing the March 1950 figures with those for March 1949, residential contract awards again showed the largest gain, a 128 percent rise, followed by nonresidential with a 53 percent increase and heavy engineering, which was up 34 percent. Residential awards accounted for $574,681,000 of the March 1950 total with nonresidential awards totaling $500,658,000 and heavy engineering $224,862,000. All these classifications showed substantial increases over the preceding month.

## TEXT OF NEW YORK'S WATER SUPPLY ORDER

HERE IS THE text of the order issued March 23 by Stephen J. Carney, commissioner of New York City's department of water supply, gas and electricity:

"Under authority of Chapter 30, Section 734, Paragraphs 2 and 3 of the New York City Charter and the provisions of Section 415 (1)-18.0 and Section 734 (4)-4.0 of the Administrative Code of the City of New York, in conformity with the provisions of Rules Numbers 117, 148 and 220 of the Rules and Regulations Governing and Restricting the Use and Supply of Water in New York City, I hereby order and direct that all air conditioning and refrigerating equipment not conforming with new rules Numbers 145, 146 and 147, promulgated as of December 30th, 1949, shall be shut off if not so conforming by June 1st, 1950. This order is necessitated by the increasing acuteness of the present water shortage crisis.

"This order shall take effect immediately."

Rules Numbers 145, 146 and 147, promulgated as of December 30, read as follows:

"145. No installation of refrigeration and or air conditioning equipment requiring the use of water shall be installed on any premises supplied from the municipal system until a permit authorizing such installation has been issued by the department to the installer.

"Applications for permits for refrigeration and or air conditioning to be installed shall specify the information requested on the application. Approved copy of the application will be returned to serve as the permit.

"Where the minimum rate of water required for the operation of the apparatus exceeds one-half gallon per minute, the supply shall be metered.

"Where the minimum rate of water does not exceed one-half gallon per minute, the supply shall be metered or charged for on an annual rate basis subject to the discretion of the department.

"146. All installations of any individual or collective system of refrigeration and/or air conditioning equipment in any premises for a single consumer shall be installed under the following specifications:

"a. All installations of any individual or collective system of refrigeration and or air conditioning equipment of three tons and over shall be equipped with a water conserving device such as economizer, evaporative condenser, water cooling tower or similar apparatus, which device shall not consume for makeup purposes in excess of five percent of the consumption that would normally be used without such device.

"b. All installations of refrigeration and/or air conditioning equipment under three tons, shall be provided with an automatic water supply regulating device so as to limit the flow of water in relation to the condenser temperature reduction requirements of the apparatus. In no case shall the equipment use in excess of two gallons per minute per ton capacity.

"147. Each direct water connection to a refrigerating and or air conditioning unit using water for cooling purposes shall be equipped with a check valve, except in installations where the water supply piping has no contact with the refrigerant. This will be the case where two substantial and independent wall thicknesses of metal separate the refrigerant from the city water supply.

"Refrigerating and or air conditioning units with a capacity of more than twenty pounds of refrigerant shall be provided with a relief valve installed on the outlet side of the check valve of the water supply connection, such relief valve being set at five pounds above the maximum water pressure at the point of installation."

## ESTIMATING BUILDING CONSTRUCTION COST

THERE IS probably no item in modern building construction "which is in a greater state of flux" than heating, ventilating and air conditioning requirements, "each of which can materially affect" the building cost, said J. P. H. Perry, consultant, Turner Construction Co., in an address before the New York chapter of the American Institute of Architects. Their characteristics "should be tied down as accurately as possible" when making preliminary estimates, he said.

The subject of Mr. Perry's talk was How Can Architects Best Make Preliminary Estimates of the Cost of Their Projects? He stated that in his opinion the best way is for the architects "to ask the contractor whom they know best or whose judgment they value most to make the preliminary estimates. While it seems obvious, nevertheless my experience over the years indicates that either architects do not know or do not accept the fact that an estimate is only as good as the information upon which it is based. This is particularly true of preliminary estimates," he said.

Air conditioning in an office, hotel or apartment house, or almost any other building, will add from $2 to $3 per sq ft depending upon how thorough a job of air conditioning is done, Mr. Perry mentioned.

Fluctuations in the cost of building over the past years must be allowed for in making preliminary estimates based on past experience,

# THE EDITOR'S PAGES

Mr. Perry said. In this connection, he presented the Turner Construction Co. cost index. Factors determining this index include labor rates, material prices, productivity of labor, efficiency of plant and management, competitive conditions, and forecast of price trends. This index does not necessarily conform to other indexes for the reason that others as a rule do not consider the last four factors, he said.

**Building Cost Index**

Average by Years

| | 1913 = 100 | 1926 = 100 |
|---|---|---|
| 1913 | 100 | 51 |
| 1914 | 100 | 51 |
| 1915 | 103 | 53 |
| 1916 | 120 | 62 |
| 1917 | 147 | 75 |
| 1918 | 166 | 85 |
| 1919 | 196 | 100 |
| 1920 | 252 | 130 |
| 1921 | 183 | 94 |
| 1922 | 175 | 90 |
| 1923 | 196 | 100 |
| 1924 | 194 | 99 |
| 1925 | 195 | 100 |
| 1926 | 195 | 100 |
| 1927 | 190 | 98 |
| 1928 | 190 | 98 |
| 1929 | 185 | 95 |
| 1930 | 165 | 85 |
| 1931 | 145 | 74 |
| 1932 | 136 | 70 |
| 1933 | 141 | 72 |
| 1934 | 160 | 82 |
| 1935 | 162 | 83 |
| 1936 | 166 | 86 |
| 1937 | 193 | 99 |
| 1938 | 188 | 96 |
| 1939 | 182 | 93 |
| 1940 | 194 | 99 |
| 1941 | 217 | 111 |
| 1942 | 245 | 126 |
| 1943 | 257 | 132 |
| 1944 | 244 | 125 |
| 1945 | 257 | 132 |
| 1946 | 318 | 163 |
| 1947 | 380 | 195 |
| 1948 | 423 | 217 |
| 1949 | 411 | 211 |
| 1950 Feb. | 407 | 209 |

## NEW *k* VALUE FOR INSULATION

CALLING ATTENTION to a recent test by the National Bureau of Standards, Marshall F. Allen, manager of the Magnesia Insulation Manufacturers Association, points out that figures heretofore in common use for the *k* factor and density of 85 percent magnesia insulation are based on tests conducted by the bureau in 1919.

The recent test made on 85 percent magnesia block of current manufacture, weighing 13.2 lb per cu ft, indicated a *k* factor, or thermal conductivity value, of 0.39 Btu per hr per sq ft per F per in. at 130 F mean temperature. According to Mr. Allen, these values are in close agreement with averages of the results obtained in numerous conductivity tests by the manufacturers on the current product. These averages were given as follows:

| Mean Temperature, F | *k* |
|---|---|
| 100 | 0.39 |
| 300 | 0.45 |
| 500 | 0.51 |

"These values represent no sudden change, of course," Mr. Allen stated. "They are simply up-to-date figures, representing steady improvement since the last Bureau of Standards tests were made some 30 years ago."

## HOW FILE ARTICLES, OTHER DATA?

YOU ARE INVITED *to answer the following question. Suitable comment on the matter will be welcomed and—space permitting—will be published and paid for at regular rates. Sketches and photos are particularly desired. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

"I remember seeing on two or three occasions some information in HPAC about how readers file articles and back issues so that data on a given subject can be located fairly easily. I'd like to set up some sort of a scheme in my office for filing articles, other published material, and miscellaneous data on heating, piping and air conditioning methods, equipment and installations.

"I wonder if readers of HPAC who have solved this problem might be willing to describe the schemes they use?"—S.D.B.

## GET AWARDS FOR TECHNICAL PAPERS

TWELVE EMPLOYEES of Dravo Corp. were awarded $500 in cash prizes for the best entries in the company's 11th annual technical papers contest, which is designed to stimulate interest in preparing articles for publication in magazines or presentation before technical and trade societies.

Three of the winning articles appeared in HPAC.

## IMPORTANCE OF ASA GROWS

RAPIDLY GROWING importance of the American Standards Association as a factor in American industrial economy, in the quality and cost of industrial and consumer goods, and in public safety is reflected in a report and chart issued by the ASA which shows that the number of new and revised American Standards approved during 1949 was almost double the average number approved annually during the speeded-up activity of five war years. More than five times as many standards were approved in 1949 as the annual average for the first 13 years of the association's operation.

## WATER PRESSURE SHOWS RADIO PROGRAM'S STANDING

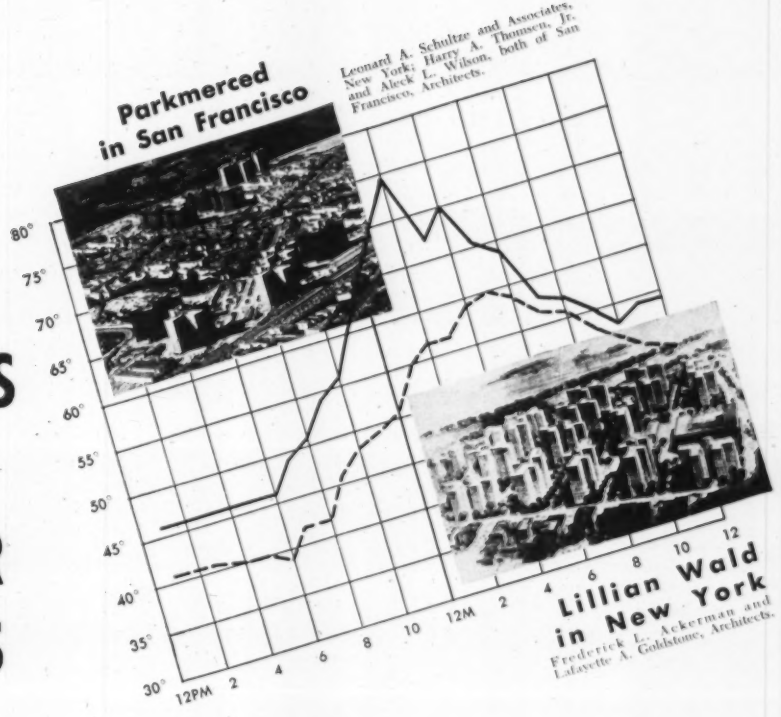
SOMEONE—can't remember who—told us the other day that the popularity of a radio program can be judged by the pressure in a city's water distribution system. He said that in England, the more popular the program, the higher is the water pressure during the broadcast. Apparently, water-using activities drop way down because people are listening to their favorites.

## GEORGE F. GEBHARDT DIES

GEORGE F. GEBHARDT, 76, former director of the department of mechanical engineering at Illinois Institute of Technology, died March 22 at his home in Miami.

He was a member of the faculty of Armour Institute of Technology (now Illinois Tech) from 1898 until his retirement in 1934, and the author of two well-known and widely-used books, Combustion (1925) and Steam Power Plant Engineering (1927).

# TWO CLIMATES ...TWO WEBSTER SYSTEMS




### In San Francisco: "Short-Hour" Heating with Steam

Pictured at left is Parkmerced, the great housing development of Metropolitan Life Insurance Company. Shown graphically is a San Francisco winter day with temperature below 70° in the morning and evening and above 70° at midday.

In designing a Webster Vacuum Steam Heating System for Parkmerced, Consulting Engineer Thomas B. Hunter knew from experience that San Francisco buildings are best served and most economically served by what is known as "short hour" heating, with steam either full on or off entirely.

Knowing too that this type of operation demands the best in radiator valves and traps and vacuum pumps, Engineer Hunter approved the selection of Webster Sylphon Packless Valves, Webster Sylphon Traps and Nash Vacuum Pumps.

### In New York City: Continuous Heating with Steam

Pictured at right is Lillian Wald Houses of the New York City Housing Authority in downtown Manhattan. It is one of eight projects of this Authority, all equipped with Webster Moderator Systems furnished under a uniform specification which is the result of long study by the Authority and its numerous consulting engineers.*

Look at the temperatures for this New York winter day. Heat is needed all day with the amount of heat varying from 44% of maximum down to 14%. What is necessary—and provided by the "controlled-by-the-Weather" Webster Moderator System—is continuous heating with variation in the rate of heating to meet the changing demand.

*LILLIAN WALD—Sullivan A. S. Patorno; WOODSIDE—Meyer, Strong & Jones; ALBANY—Feilheimer, Wagner & Vollmer, Architects and Engineers; SOUTH BEACH—V. L. Falotico Associates; TODT HILL—E. V. Marquis; BRONX RIVER—Sullivan A. S. Patorno; DYCKMAN—Sullivan A. S. Patorno; FARRAGUT—Paul Wunderlich.

---

Whether it is a Webster Vacuum System for San Francisco or a Webster Moderator System for New York, each room occupant can make a positive heat shut-off with a Webster Radiator Valve—a prime necessity in large, multiple-unit housing.

Wherever you are—whatever your climate and heating requirements—there is a Webster System to fit your needs, and you are almost sure to find a long-resident Consulting Engineer in your community who knows your climatic requirements and knows from experience how well Webster equipment can serve you.

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**ARCHITECT:** James Ludwig
**BUILDERS:** Orleans Cons. Co.
Tyson Construction Co.
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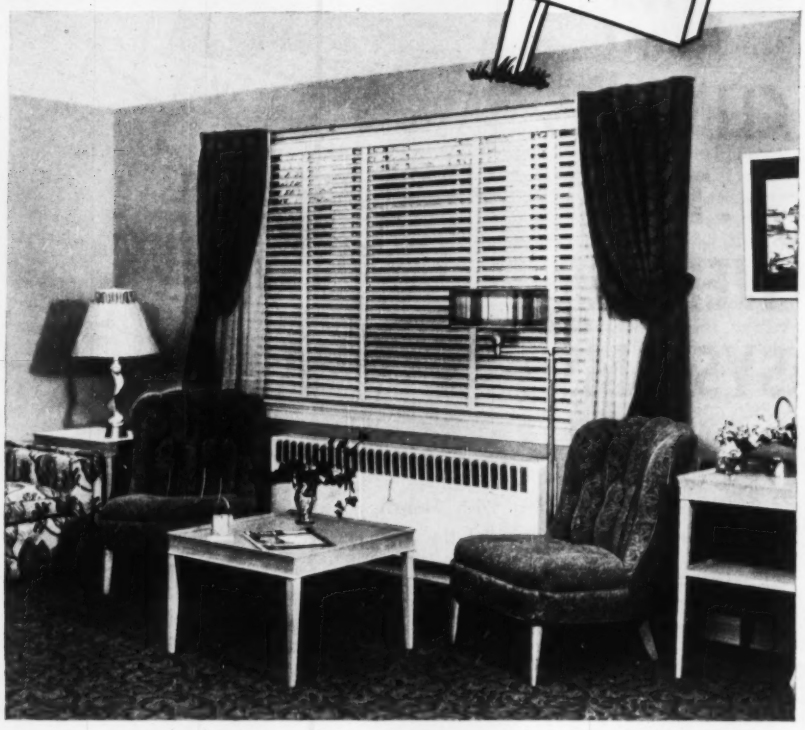

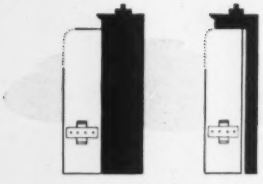

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Every heating contractor can profit by the experience of the builders of Lynnewood Gardens—who did not choose just "any" convectors for their 1,798-unit apartment project, but after critical comparison of several good makes chose NESBITT MODEL U CONVECTORS. Quality, design, construction, finish, and the universal features which save manhours of installation time SOLD them. Owners and tenants are SOLD by the same worthy advantages. When you need COMFORT you need CONVECTORS. And whether it's one convector or a carload, you save time and money and service calls—with NESBITTS.

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*SOLD EXCLUSIVELY THROUGH PLUMBING AND HEATING WHOLESALERS*

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DO YOU HAVE something to say about any of the articles published this month? An additional comment, or perhaps a question on some point? Or do you want to express your views on some other matter of interest to heating, piping and air conditioning engineers or contractors? We follow here the custom at engineering society meetings of allowing a period for discussion following presentation of a paper. You are invited to participate. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

## PROPER ANGLE FOR GREASE FILTERS

CAREFUL STUDY of the article by Robert C. Soronen on kitchen range hoods in the April HPAC leaves the impression that the paper is aptly conceived and well written.

In the section on types of range hoods, the statement is made that filters are installed as indicated on shop fabricated supports, bent to the required angle necessary to accommodate the selected filter size. The drawings seem to indicate that the filters can, as required, be installed either horizontally or at various angles.

Our laboratory findings have shown that grease or cooking oils can drip from the face of a filter installed at an angle of 45 deg and this has prompted us to recommend that grease filters be installed at an angle not greater than 30 deg from vertical and that a drip tray be provided to catch the grease after it seeps through the filter medium to the bottom of the filter frame and then drains out. This recommended installation angle insures that proper drainage will be effected.

Horizontal installations are not recommended but, if properly serviced, can be used effectively in certain instances; the height of the filter bank from the range, the concentration of grease, and face velocities at the filter, all are factors which determine the length of time a filter in a horizontal position can function safely. It has been our observation that grease filters in horizontal positions have a considerably shorter service period between cleaning than those installed in a 30 deg from vertical angle bank. When oils are used in cooking and are caught on a horizontally installed filter, it is obvious that there is no place for this liquid to drain except by dripping straight down and off the filter.—G. R. HOLTZ, Farr Co.

## AIR QUANTITY, FILTER ANGLE FOR RANGE HOODS

ROBERT C. SORONEN offers some excellent suggestions on the design and installation of kitchen range exhaust hoods in his article in the April HPAC.

In calculating the volume of air to be exhausted, we believe that the quantity of 60 cfm per sq ft of range hood is too small to give adequate fume removal, particularly if there are any crossdrafts. Also, in warm weather, kitchen comfort will be improved by exhausting greater quantities of air. We prefer to see quantities of about 100 cfm per sq ft of hood area for hoods having one side closed by a wall and about 150 cfm per sq ft of hood area for suspended hoods having four open sides. When using the above quantities, it is sometimes desirable to provide a two speed motor on the blower to enable slowing the fan down on cold winter days. This prevents exhausting too much warm air.

We have seen a number of installations where the hood was installed entirely too far from the floor, and we would like to concur with Mr. Soronen's suggestion of keeping the hood as close to the range as is permitted by headroom considerations. We suggest overhanging the edge of the hood over the edge of the range by about 0.4 of the clearance between the base of the hood and the top of the range. This would normally give somewhat more overlap than the 6 to 12 in. suggested by Mr. Soronen.

In any case, where headroom permits, we prefer to see the grease filters installed at an angle as shown in Mr. Soronen's Fig. 1 and Fig. 2, rather than flat as in his Fig. 3. Installing the filters at an angle accomplishes two ends:

a) A large volume is left in the hood to permit the collecting of "puffs" of vapor (such as those coming from a French frier) which might spill out of a hood having very little volume, such as the hood of Fig. 3.

b) If the accumulated grease deposit on the filter melts, it will drip at random points from a horizontal filter. This is unsanitary to food and irritating to personnel on whom the grease drips. If the filters are mounted at an angle of not less than 45 deg with the horizontal, the grease will tend to run down the face of the filter and drip from the lowest edge. It can be collected at this point in a drip trough.—CARL B. ROWE, Research Products Corp.

## COMFORT WITH RADIANT HEATING

F. W. HUTCHINSON'S article in the December issue was no news to those of us who have had actual experience with radiant heating. We found out a long time ago that the convection component was much more important than some of the literature would indicate.

This fact became most obvious when we discovered on actual jobs that ordinary on-off controls produced satisfactory results to the occupants. The only explanation appeared to be convection to a much greater degree than theoretical considerations indicated.

Unlike some of HPAC's readers, we did not ever have difficulty explaining to the uninitiated how heat travels down from a ceiling

panel. True, they thought that heat always travelled up, but we would ask, "Does heat rise, or is it heated air which rises?". Usually, this serves to point out the difference between rising heated air and radiated heat, which theoretically at least, travels equally well in all directions, assuming a difference of temperature in those directions.

We do not think that the admission of convection represents any particular disadvantage to radiant heating in any case. Far from it, we think, for—convection notwithstanding—radiant heating is still, in point of actual performance, one of the most comfortable systems yet devised.

We hope the columns of your excellent magazine will always be "open for discussion," for we enjoy the "cons" as much as the "pros."—W. A. CONNOR, service engineer, radiant heating div., Page-Hersey Tubes, Ltd.

## PERIMETRIC HEATING BLANKETS COLD WALL

REFERRING TO Samuel R. Lewis' recent article in the December HPAC, wherein he discussed the use of finned radiators continuously installed around the outside walls in classrooms, it should be pointed out that a great advantage of this perimetric heating is the blanketing of the exposed wall with warm, convected heat at the point of greatest infiltration.

The exposed walls of a building act as radiant cooling panels, and since it is desirable to have the "inner skin" temperature of the walls raised, this can be accomplished effectively with extended fin surface. This type of installation not only has the effect of raising the inner surface temperature but also tempering the downdrafts from sash infiltration. More important, it sends a current of heated air up to meet the downdrafts.

This type of installation eliminates cold spots, drafts, and with the gentle circulation of air we find the temperature between floor and ceiling varies a minimum. It also does away with a considerable number of valves, fittings, risers and returns, thus reducing the installation costs, as referred to by Mr. Lewis.

It might be well to point out that the application is equally effective in any type of building whether it be residential, industrial or institutional.

Mr. Lewis is no doubt one of the leading authorities on perimetric heating not only theoretically but also on practical installations in all parts of the country.—T. L. ARNOLD, Vulcan Radiator Co.

## WELDING SPEED FOR ICE RINK PIPING

I HAVE READ the article by M. N. Vuchnich on the welding of piping for an ice rink, published in the April issue; this is certainly interesting.

Inasmuch as the piping is one of the major items of volume, weight and cost in the construction of any skating rink, the ingenuity described in this article in speeding up the assembly of the rink piping and reducing the welding cost has undoubtedly gone a long way toward reducing the total cost of the erected rink.

The application of the welding jig for this field erection job has permitted this pipe work to be welded at a speed of 2 min per joint, which is phenomenal.

It is common practice to count on a welder making six $1^1/_4$ in. pipe welds in the shop per hour without the use of jigs. Similar $1^1/_4$ in. pipe welds made in the field without a jig are a little slower and usually run about four welds per hour.

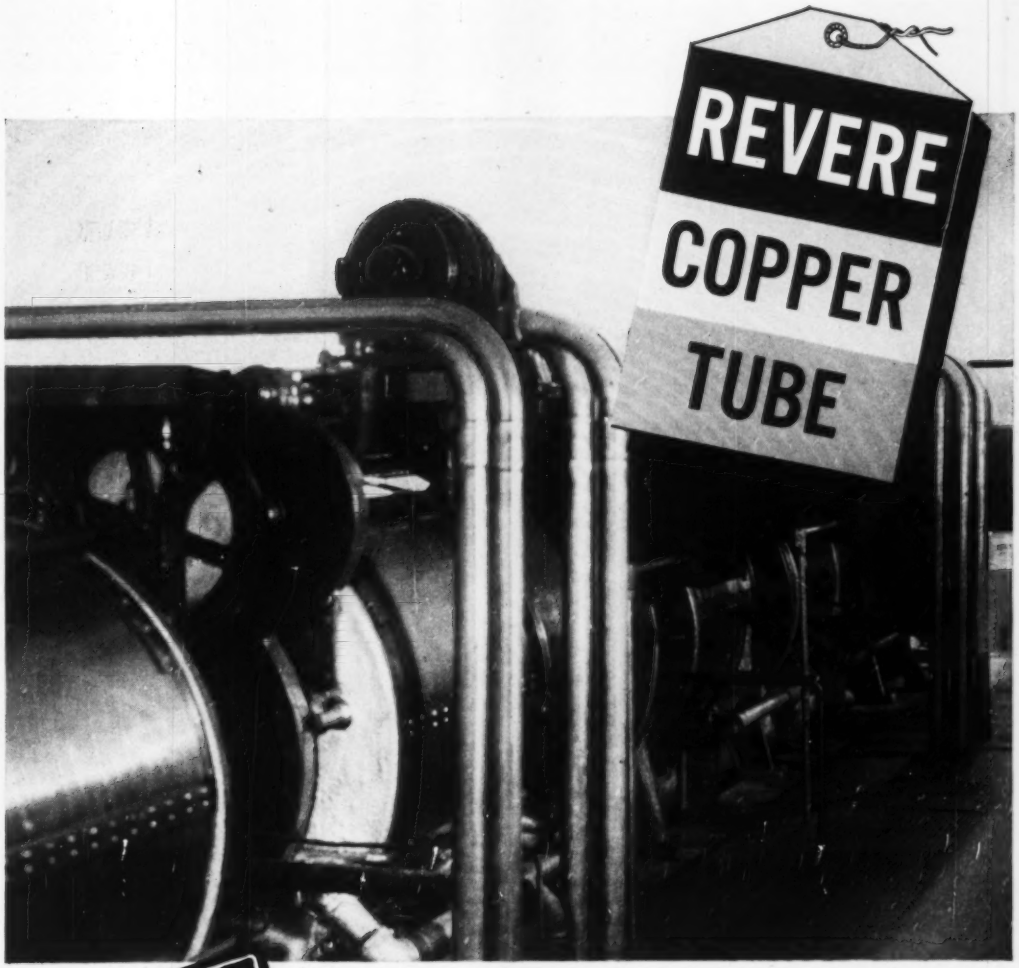
The article mentions a speed of 2 min per weld or at the rate of 30 welds per hour. Possibly this rate could not be maintained hour after hour due to loading and unloading the welding jig, but even if the rate was 20 to 25 per hour, this would still be at one-third to one-fourth of the average cost of field welds without jigs. Therefore, with a rink involving 2400 butt joints in the rink collage, it is obvious that a considerable amount of cost has been saved by this ingenious welding jig method.—R. C. DOREMUS, Detroit Ice Machine Co., and member of HPAC's board of consulting and contributing editors.

ANSWERING THE above comment, the information as to welding speed is correct as given in my article, but there is one point which perhaps should be explained. There was only one welding operator on the job but he had two men helping him loading and unloading the welding jigs. There were two welding jigs and each helper worked on one jig, so there was a total of three men, the welding operator and two helpers on the job.—M. N. VUCHNICH, president, Lincoln Electric Co. of Canada, Ltd.

## WEIGHT OF MAGNESIA PIPE INSULATION

I WAS VERY much interested in the comment on page 72 of the April HPAC regarding the weight of magnesia insulation. In compiling the table given in my article on How to Space Pipe Supports, I had used the weight of insulation values from a bulletin published by a manufacturer of piping hangers.

It is quite true that the Magnesia Insulation Manufacturers Association manual shows, in most cases, values which are a little lower. It is gratifying to know that the figures I used are on the safe side. It is not clear from the MIMA bulletin as to whether the data include an allowance for the two layers of roofing felt which must be added in some cases. The source I used does not make this point clear either, but I believe that the values in Table 1 of my article (page 93, February HPAC) are good enough for most design purposes.—THEODORE E. BRIDGE.

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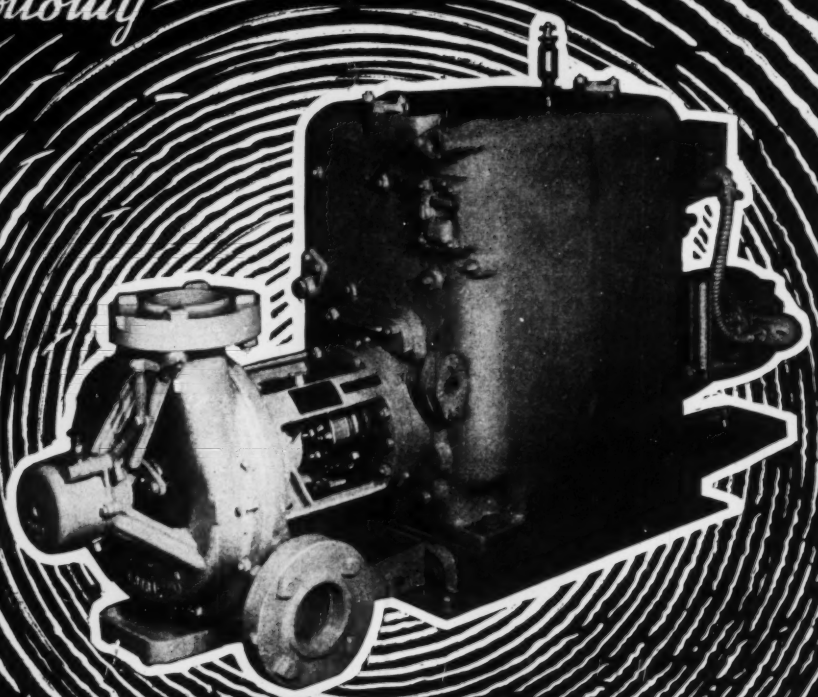

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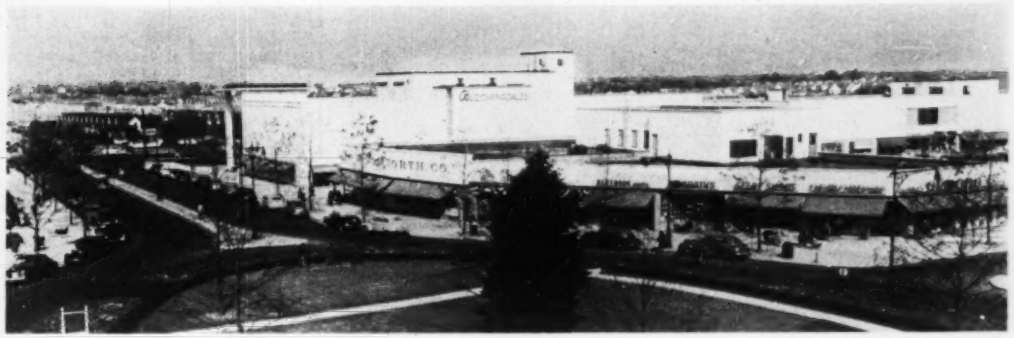


*Buildings in the commercial area at the Fresh Meadows project are furnished with refrigeration for air conditioning from a central plant, the refrigeration effect for large consumers being metered*

# METERING Air Conditioning for Fresh Meadows Commercial Users

*LEWIS SMITH and W. J. STEINERT (of C. A. Dunham Co. and chief engineer of the Fresh Meadows project, respectively) describe the method of furnishing refrigeration from a central plant for air conditioning stores, shops, a theater and other buildings in the commercial area at Fresh Meadows. Condensing water is obtained from two wells, and is returned to two other diffusion wells because of the strict regulations governing water supply on Long Island. An extensive chilled water distribution system serves the consumers, and meters reading in therms are employed to measure the amount of refrigeration for air conditioning supplied the large users*

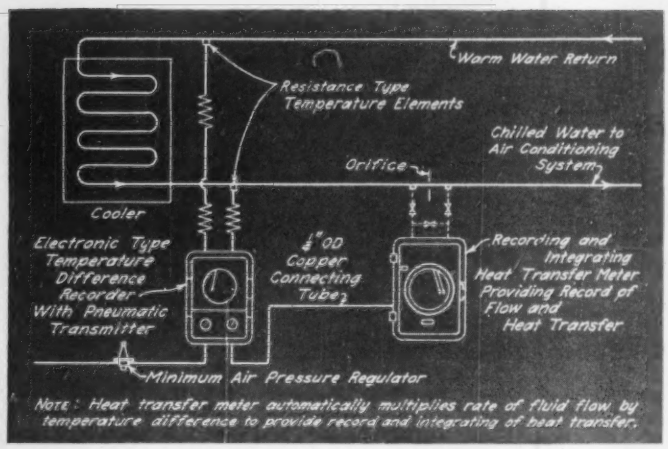
FRESH MEADOWS is not just another big apartment house project. It is a city in itself—a city of 11,000 inhabitants created on former country club grounds. Though within the limits of New York City, it is on land where no one lived before and where surrounding shopping facilities were meager and in no way adequate for the new population. Therefore, the New York Life Insurance Co., the owner, felt that a new shopping center should be created; in order that this development might be properly carried out, it was taken in hand by the insurance company and built on its own property.

The stores, shops and other commercial establishments of today are either fully air conditioned the year 'round or at least must have summer cooling. Since the buildings containing these spaces are owned by the insurance company, which was already committed to furnishing heat, it was evident that cooling and ventilation might also be considered as a utility. It thus became necessary for the owner to enter into the business of supplying refrigeration and the means for cooling the commercial spaces.

A number of the commercial spaces are quite large, such as a 2100 seat theater, a department store, bowling center, supermarket and an office building for professional men. While small units of the self contained type could have been used in the many small shops, the larger places require cooling plants built into the structures. Thus, it would not have been possible—except to a small extent—to leave the matter of cooling to the tenants to arrange for themselves.

### Condensing Water a Serious Consideration

A very serious consideration was the supply of condensing water. City water for such large plants is too expensive to waste to the sewer.


Warm Water Return
Resistance Type Temperature Elements
Chilled Water to Air Conditioning System
Orifice
Cooler
Electronic Type Temperature Difference Recorder With Pneumatic Transmitter
¾" OD Copper Connecting Tube
Recording and Integrating Heat Transfer Meter Providing Record of Flow and Heat Transfer
Minimum Air Pressure Regulator
NOTE: Heat transfer meter automatically multiplies rate of fluid flow by temperature difference to provide record and integrating of heat transfer.

**A metering system was developed which reads in therms (100,000 Btu) as a rate of flow indicated on a recording chart and which totalizes the therms on a counter. The meter automatically multiplies the rate of chilled water flow by the temperature difference between flow and return**

It now turns out that had individual plants with city water been adopted, the present emergency due to shortage of city water would have forced the suspension of all cooling.

Ground water is available, but the New York state conservation department, which has been watching for several years the alarming drop in ground water level under the west end of Long Island, was empowered by an act of the legislature in 1933 to require the consent of the water power and control commission before the sinking of any well, except for agricultural purposes, taking more than 69 gpm from the ground and by further act in 1935 to require that no well driller operate on Long Island without a state license. By that time, the level of the ground water had dropped as much as 40 ft in places and in some such locations was 30 ft below sea level—with the resulting salting of the water in those areas. In order to prevent further depletion of ground water supplies, the commission has granted permission for sinking new wells over 69 gpm capacity only if all the water is put back into the ground by means of diffusion wells.

Since a number of the Fresh Meadows users require a great deal more than the permitted flow it would have been necessary to indulge in a multiplicity of supply and diffusion wells which could not be done in a confined area without slowly raising the ground water temperature in the area. Aside from the water problem, the cost of operation and maintenance of a number of compressor plants, and the cost of electric service connections and the value of the space needed to house the separate plants led the owners to the conclusion that a central plant was the best solution.

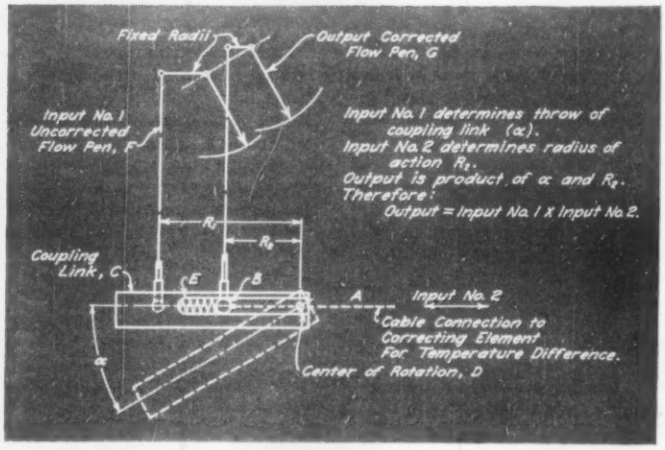
Such a plant could have been set up in the commercial area of the project, with its own operating staff, circulating chilled water to the various points of use, but there was already a central boiler plant under construction for the entire job and if both heating and refrigerating plants were in one place, the same crew would handle both services. Therefore, it was decided to build the refrigeration plant as an addition to the boiler plant and spend the extra money required for the large chilled water circulating lines, some 2000 ft in total length, to connect the commercial area to the plant.

At the present time, chilled water is supplied to the theater, the department store, about 24 stores and shops, the bowling center, the professional building and two banks, with provision for future users.

## Two Supply and Two Diffusion Wells

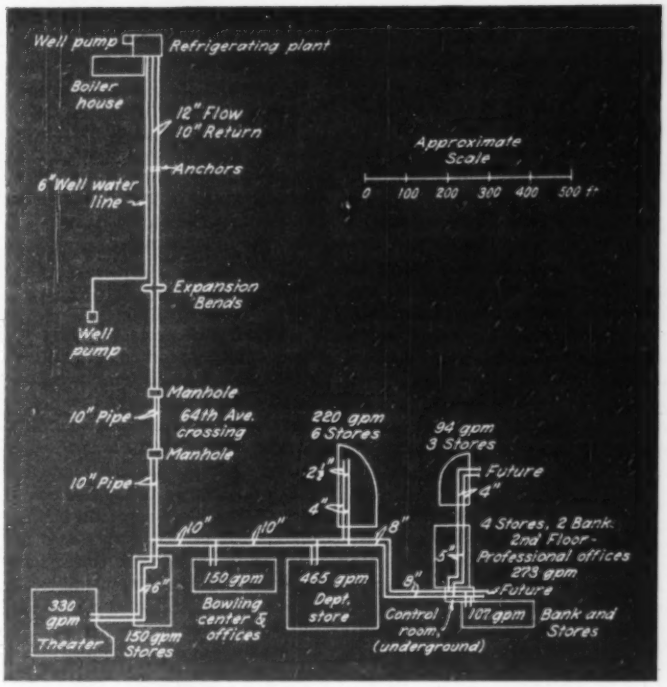
The underground water has a constant annual temperature of 52 deg. For a plant with a capacity of 1200 tons of refrigeration 1000 gpm of condensing water is required. Previous knowledge of the water table and flow at this point showed that two wells about 600 ft apart and 100 ft deep could be relied on for 500 gpm each without interfering with each other. One well was sunk at the central plant, and the other 600 ft away and across the flow.

**An air line from the temperature difference recorder is connected to a bellows in the flow meter. From this bellows, a cable *A* is connected to a slider *B* in the slotted link *C* pivoted at *D*, slider *B* being opposed by spring *E*. The pen arm *F* of the flow meter is attached to the free end of link *C*. Thus, pen *G* is positioned according to the temperature difference and the flow**


Fixed Radii
Output Corrected Flow Pen, G
Input No. 1 Uncorrected Flow Pen, F
Input No. 1 determines throw of coupling link (α).
Input No. 2 determines radius of action $R_1$.
Output is product of α and $R_2$.
Therefore:
Output = Input No. 1 X Input No. 2.
$R_1$
$R_2$
Coupling Link, C
E
B
A
Input No. 2
Cable Connection to Correcting Element For Temperature Difference.
α
Center of Rotation, D

The two diffusion wells were sunk about 500 ft away on the downstream side of the groundwater flow so that the heat added to the water would be carried down and away from the supply wells. To conform with the requirements of the water power and control commission, the lines out of the supply wells and into the diffusion wells are metered to insure against loss of water, and no connections to the circulating lines are permitted which would allow the escape of any water except into the diffusion wells.

The wells have 16 in. casings and the pumps are of the five stage turbine type with 8 in. discharge pipes. They are driven by 30 hp, 1760 rpm, vertical shaft motors. Each pump has a capacity of 500 gpm. After leaving the condensers, the pump discharge lines are consolidated and pass through a reverse acting pressure reducing valve set to maintain a constant 45 lb pressure on the pumps to prevent overloading of the motors due to loss of pressure.




**The nearest user is some 1300 ft distant from the refrigerating plant and the farthest customer is at present about 2200 ft away**

## The Chilled Water Circulating System

There are two centrifugal compressors running at 5000 rpm and driven by 600 hp, 4160 volt, 1800 rpm, variable speed motors through reduction gears. The controllers have 12 speeds. The compressor speed is constantly adjusted manually to keep a constant temperature difference between the water leaving and returning to the coolers so that the power input can be controlled to conform with the system requirements. A substantial saving in power has been achieved in this way.

Chilled water is handled by three centrifugal pumps operating in parallel. These pumps have capacities of 300, 660 and 960 gpm and are driven by 30, 60 and 75 hp, 1760 rpm motors, respectively. Since the cooling load varies widely, these pumps are run in various combinations to give 300, 660, 960, 1260, 1620 and 1920 gpm.

The temperature difference between the flow and return mains is indicated and recorded, and is designed to be 15 deg—45 deg leaving the plant and 60 deg returning. This higher than usual difference was the result of striking a balance between original installed cost and operating cost. At present, due to the fact that the system has not yet been extended to its full capacity, the temperature difference is held at 10 deg. A change in load demand results in a change in this temperature difference and as soon as this change is noted, the difference is brought back to 10 deg by changing the pump combination. Close observation of conditions and adjustment of the pumps have been found to result in a substantial saving in power cost.

Some parts of the circulating system are considerably higher than the circulating pumps. An expansion tank is installed in the plant and connected to the return line. By keeping the air pressure above the water in this tank at not less than 15 lb, the whole circulating system is kept full of water all the time, so there is an automatic air pressure control set to cut in at 15 lb and out at 25 lb.

Experience has shown that about 30 lb pressure will circulate the entire system at maximum flow at the present time. With the completion of the future extensions, substantially more pressure may be required and the back pressure may have to be raised. Hence, the circulating pumps were designed for 100 lb discharge pressure and at present are hand throttled to maintain that pressure. A bypass connection, with an automatic flow valve, between flow and return pipes is set to keep 50 lb on the system.

## How Refrigeration Is Metered

In order to keep a continuous check on the performance of the refrigerating plant as to efficiency, rate of production of energy and total energy produced in a given time, as well as to provide a suitable means for measuring the energy delivered to at least the large consumers as a basis for charges for the service, the consulting engineers searched for a suitable device to accomplish all these things. A difficulty arose in that the temperature difference between the chilled water leaving and returning to the plant is much smaller than encountered under the usual conditions to which such metering devices are applied. An error in indicating either outgoing or return

**At each of the principal flow points in the chilled water system, an orifice is installed which is connected to a gage calibrated in gpm. Much use is made of these devices to determine what is going on in the system and to achieve a balanced flow condition**

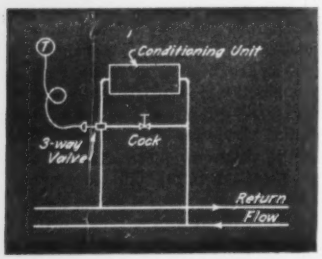
temperatures might not be of consequence as a percentage of the temperature itself, but when the two errors are compounded and related to the temperature difference, the total error could easily be in the order of 10 percent. In addition, the water flow might at times be below the usual range of meter accuracy, yet since the temperature difference at low flow might be considerable, the total error could be excessive.

By cooperation between the meter industry and the consulting engineers a metering system was developed which reads directly in therms (100,000 Btu) as a rate of flow indicated on a recording chart and which totalizes the therms on a counter. While the method is not entirely new, it is believed that this is the first application to the metering of refrigeration for air conditioning.

### Two Instruments Employed

Two instruments are employed, as shown in an accompanying drawing, connected only by an air line.

One instrument is actuated by two electrical resistances, one in the flow main and one in the return main. These are connected into a wheatstone bridge circuit and the unbalanced current flow is transmitted by an electronic tube to a power amplifier which varies the energy of a solenoid operating the pen on the chart, thus giving a reading directly in degrees temperature difference. At the same time, this solenoid varies the opening of an air leak valve in a pneumatic line between it and the Btu meter by which the transmitted air pressure ranges from 3 to 15 lb.




The flow meter is of the spring loaded "S" tube ring balance type operated from the pressure difference across an orifice in the chilled water line. The spring corrects inaccuracy at low flow.

### How Pen Is Positioned

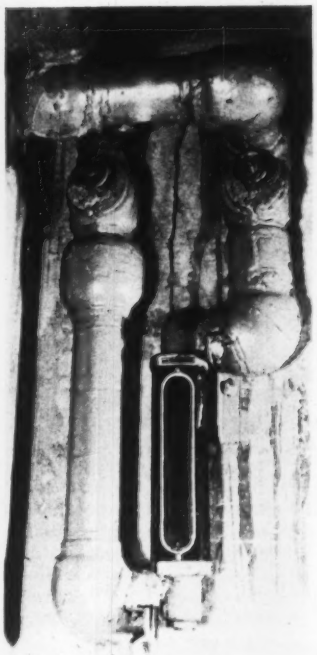
The air line from the first instrument is connected to a bellows in the flow meter. From this bellows a cable *A* (see sketch) is connected to a slider *B* in the slotted link *C* pivoted at *D*. Slider *B* is opposed by spring *E*. The pen arm *F* of the flow meter is attached to the free end of link *C*. Examination of the linkage shows that pen *G* is positioned according to the relation of temperature difference and flow and draws a line on a chart which can be calibrated to read in therms.

The integrator mechanism has a ratchet wheel turned by pawls on an oscillating arm, the time of engagement between the pawls and ratchet being determined by a tripping device operated by linkage from the flow meter pen mechanism. An unusual feature is the use of two ratchets and two pawls side by side. There is a limit in the fineness of teeth cut in the rim of the wheel but by using two wheels with the teeth in a staggered position the effect is to double the sensitivity of the meter. A counter is operated from the wheel and reads directly in therms.

These Btu meters have been installed at the refrigerating plant, and at the theater and the department store, where they serve to measure the therms used on which charges to the consumer are made. Smaller customers are billed on a flat rate.

### Piping for the Chilled Water

The chilled water distribution system is shown in one of the sketches. The nearest user is some



1300 ft distant from the refrigerating plant and the farthest customer some 2200 ft (at present). Leaving the plant, the flow main is 12 in. but reduces to 10 in. at a manhole 800 ft away. The return main is 10 in. The flow main is standard weight steel pipe with welded joints. The pipe is insulated with sectional molded covering sealed with a monolithic asphalt coating. Overall is a presealed conduit with welded joints. This conduit was tested for leaks in sections after installation with 10 to 15 lb air pressure. The return main is standard weight steel pipe with welded joints, protected with asphalt covering. All piping was tested to 125 lb after installation before the covering was applied.

Experience through the first summer showed that the total refrigeration load often dropped to 400 tons or less for considerable periods.

**If ordinary two-way shutoff valves were used for each conditioning unit, and these were practically all closed, the circulation in the system would be so slow that the required water temperature could not be maintained for a user at the far end of the chilled water distribution system. To solve this problem, a bypass from the flow to the return line was installed at each customer's connection**

This load could be handled with the ground water at 52 deg with a 10 deg rise. Connections are being installed to circulate this ground water through the system during those times, permitting the compressors to be shut down—with an obvious saving in electric power cost.

### Bypass With Three-Way Valve

A problem not often encountered in the design of a chilled water system required particular attention and a solution. With consumers offering such a wide variation in cooling and dehumidifying requirements, in physical size, in hours of operation and in distance from the central plant, it became necessary to make sure that each one would get the right quantity and temperature of chilled water at the right time. For instance, a drugstore on the far end of the distribution system might require air conditioning at 11 p.m. when practically all other consumers are closed. It was realized that under these circumstances, if ordinary two-way shut-off valves were used for each conditioning unit and these were practically all closed, the circulation in the system would be so extremely slow that the required water temperature could not be maintained at the drugstore.

To solve this problem, a bypass from the flow to the return line was installed at each consumer's connection with a three-way thermostatically operated flow valve. This valve was built so that when the controlling thermostat is satisfied and the valve closes off the flow to the unit, there is a partial flow through the bypass. A balancing cock with an indicating dial was put in each bypass to enable a precise adjustment of this flow to be made. Coupled with the flow indicators described in the next paragraph, it is possible to have an adequate supply of water at proper temperature available without delay for each consumer at all times.

### Flow Indicators in Circulating System

At each of the principal flow points an orifice is installed in the chilled water flow line. Connected to each such orifice is a gage which shows the flow in gpm through the orifice. An orifice in the base of the gage is calibrated so that the flow through the gage is in exact proportion to the flow through the orifice. The internal diameter of the gage glass is made to exact dimensions and is slightly tapered, being larger at the top end. A stainless steel float rides to a height determined by the velocity of the water through the glass, which is marked in gpm so that at all times the flow in the main may be observed. Much use is made of these devices to determine what is going on in the system and to achieve a balanced condition of flow.

The customers' air conditioning equipment is of the usual type. The heat loss is handled by convectors under subatmospheric control. The heating of air for winter ventilation and cooling for summer use is done by a combination of preheaters and reheaters, cooling coils, air washers, and dampers for both outdoor air and recirculation air, with humidity control.

The owner and manager of Fresh Meadows is the New York Life Insurance Co. The architects were Voorhees, Walker, Foley and Smith, working with New York Life's housing department architect and engineer. The consulting mechanical engineers were Meyer, Strong and Jones. The general contractor was the George A. Fuller Co. All the refrigeration system and most of the air conditioning was installed by J. I. Murphy, Inc.

* * *

An article in the June 1949 HPAC described the heating at the Fresh Meadows project.

## *Shovels in Comfort*

THE OPERATOR of this giant electrically powered crawler type shovel handling hot slag from a Pittsburgh steel mill is protected from excessive heat and fumes by an air conditioning unit mounted atop the cab which supplies the cab with 400 cfm of conditioned air, holds inside temperature at approximately 80 F. Air drawn into the unit is filtered and passed through fume removing chemical canisters. The refrigeration compressor uses "Freon-114." No water is needed. The shovel operates in two parallel trenches 600 ft long into which 2800 F molten slag is poured. Recovered slag is processed for building blocks and other construction materials. (Photo courtesy Dravo Corp.)

# *Heating, Piping and Air Conditioning at the*

# MIDWEST POWER CONFERENCE

***AS IS ITS regular custom, the 1950 Midwest Power Conference devoted a good part of its program to discussion of heating, piping and air conditioning subjects. We print here selected excerpts from some of these papers***

SOME 2500 engineers met last month at Chicago's Sherman hotel for the 12th annual Midwest Power Conference, sponsored by Illinois Institute of Technology with the cooperation of 18 midwestern universities and professional societies.

Published here are excerpts from some of the papers of particular interest to heating, piping and air conditioning engineers and contractors. Complete proceedings of the conference will be mailed without further charge to each registrant, and additional copies may be secured for $3 each from the conference secretary, Edwin R. Whitehead, Illinois Institute of Technology, 3300 Federal St., Chicago 16.

## COST OF FABRICATING INDUSTRIAL PIPING

ENGINEERS GENERALLY have been prone to make assumptions regarding the costs of piping fabrication without obtaining factual data on which to base their conclusions. At the Frank Fehr Brewing Co., we have been engaged in an extensive expansion program, and therefore wished to obtain factual data on which to base the selection of fabrication methods for all our pipe work. We were well aware of the fact that both labor and material were substantially higher since the war, and that the cost of piping is no small item in the construction of new plants. We also realized that maintenance is of paramount importance.

An increase in production made it imperative to place a new boiler plant in operation at the earliest possible date to meet increased demands for steam. On this project, we specified that all lines 2 in. and larger were to be welded, except the city water lines. This job gave us a splendid opportunity to check the comparative costs of piping fabrication. The next project was a complete new bottling plant. After analyzing the data obtained for the power plant, we specified that all piping was to be welded except a 6 in. water line. We continued our survey and collected data throughout the project.

To summarize, here are the points which brought about the decision to standardize on welded construction for our plant: (a) A welded pipe line is neat in appearance. (b) A welded pipe line is strong. (c) There is little or no maintenance on a welded line. (d) Delays in placing a new pipe system in service are avoided with welded construction. (e) When all factors—such as maintenance and leakage—are considered, welding is a very definite advantage in sizes down to 2 in. on all services, and in the case of refrigerant lines, welding or brazing should be employed regardless of size.—CHARLES SCHOTT, chief engineer, Frank Fehr Brewing Co.

## CONTROLS CUT HEATING COST 10-25 PERCENT

ONE OF THE MOST common sources of waste is the overheating of buildings, and much of the work involving the economical use of steam is in connection with building temperature controls. Experience indicates that savings of from 10 to 25 percent can be expected by the installation of control equipment. In many cases, the overall comfort of the building is improved by the installation of the temperature control.

There are many types of temperature control systems ranging from simple thermostats to automatic cycling controls and differential pressure control systems. The cost of the control must be balanced against the savings in steam consumption which can reasonably be expected.

In general, the heating systems of buildings using temperature controls have performed acceptably but a considerable number of operating difficulties have been encountered. Some of these difficulties are caused by shortcomings of the heating systems rather than by the controls.

Few have been caused by mechanical defects of the control equipment. The majority of difficulties, however, are caused by the failure of the building operators to understand and appreciate the equipment itself. This is largely a matter of education and can be corrected only by continual effort.

The efficiency of the building operating personnel frequently has more influence on the economical use of steam than any other single item. Improvement of the efficiency of operating personnel is largely a matter of education of the building management as well as the operating staff. In many cases the building management, in an effort to minimize labor costs, employs unskilled labor to operate and maintain their mechanical equipment. Under these circumstances, waste is inevitable.—G. D. WINANS, assistant superintendent of central heating, The Detroit Edison Co.

## NIGHT SHUTOFF SAVES HEATING STEAM

STUDIES AND experiments have demonstrated that one of the most fruitful methods of conserving heat is to shut off the heating system completely during the non-occupied periods, except as may be necessary to prevent freezing. [A study of the savings effected by night shutoff was made in a building which is used chiefly for offices which may be occupied until 8:00 p.m. This building has] a conventional two pipe vacuum return heating system. A complete three-zone temperature control system with time clocks provides automatic night and week end shutoff. During a 24 hr period, when the control was operated in the normal manner, 55,650 lb of steam was used. The small amount of steam used during the period when the main heating system was shut off was required for heating the lobby and first floor stores. When the control operated to maintain a temperature of approximately 75 F throughout the 24 hr period, 66,450 lb of steam was used.

It is probable that night shutoffs may not be as effective in all cases, but we have proved that worthwhile economies are accomplished even where the steam can be shut off for only a few hours each day. Separate steam supply lines to those portions of the building which regularly require long hour heating pay for themselves in a very short time.—G. D. WINANS, assistant superintendent of central heating, The Detroit Edison Co.

## MANY USES FOR HEAT DRIVEN REFRIGERATION

LARGE REFRIGERATING units from approximately 100 up to 3000 hp, using heat as the motivating element instead of electric power, have had, in people's minds, the possibility of many potential advantages over motor driven equipment.

Today, about 80 percent of the large centrifugal installations are driven by electric motors. There are, however, the following applications which make the heat driven unit [turbine driven centrifugal refrigeration or water absorption refrigeration machines] preferred because of cheaper owning and operating costs:

1) Where cost of fuel is cheap and is fairly automatic, such as gas in the southwest.

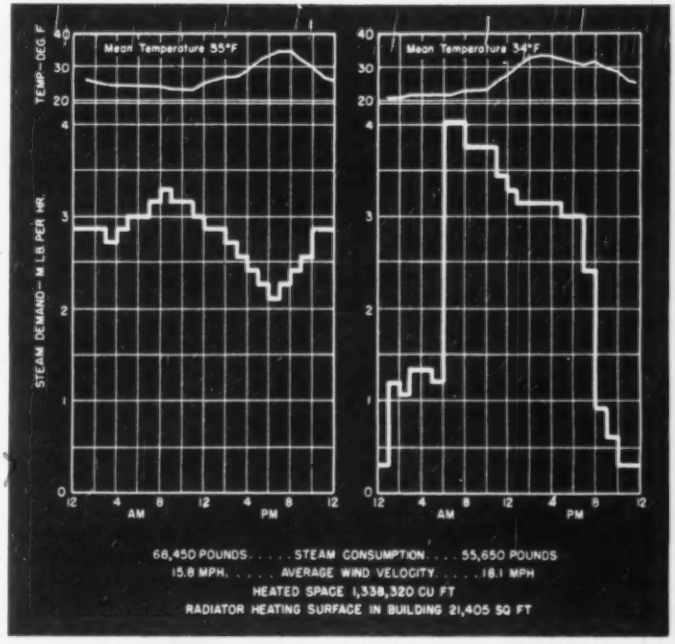
2) Where the electric utility sells steam as a byproduct.

3) Where the equipment can be used in heat balance—that is, energy from the steam being converted into mechanical power before using the heat content of the steam for heating a building, cooking brew in a brewery, or heating water for a kill floor in a packing plant, etc.

4) Some industrial plants have all the size and cost saving features as does the electric utility in the nature of steam generating cost and, therefore, can consider the use of heat motivated refrigeration equipment.

Markets for refrigerating equipment have changed from the typical cold storage and ice plant applications to the use of refrigeration in many applications. Generally speaking, more refrigeration is being installed for air conditioning and industrial processes than for any other use. A recent trend in the food industry has been, of course, quick freezing for more palatable products, and the concentration of fruit juices by refrigeration and freezing.—O. E. GAMMILL, JR., Carrier Corp.

**Night shutoff saves heating steam, as evidenced by this information from an office building. When inside temperature was maintained for the 24 hr period, 66,450 lb of steam was used as compared to 55,650 with night shutoff**



## AIR CONDITIONING UPS SUMMER STEAM SALES

STEAM FOR AIR conditioning has been used very successfully for several years where it has been available at 100 to 200 psi.

It is used to drive centrifugal machines or, directly, in the ejector type of machine. Recently, the absorption cycle of refrigeration has been applied to air conditioning units using water as a refrigerant and some salt solution, such as lithium bromide, as an absorber. These machines will operate on steam pressures from 0 to 15 psi.

[In a study of the steam consumption of a small department store before and after the installation of steam operated absorption air conditioning, it was noted that] 42 percent of the total steam consumption for the year was for air conditioning. You will see why the central station heating man becomes enthused about the possibilities of the use of steam for air conditioning to increase summer steam sales. There are several of these machines in operation throughout the country and it is expected that, where steam is available the year 'round, the use of these units will become popular and will give the steam utility a desirable increased summer output.—G. D. WINANS, assistant superintendent of central heating, The Detroit Edison Co.

## NO TWO CITIES HAVE SAME POLLUTION PROBLEM

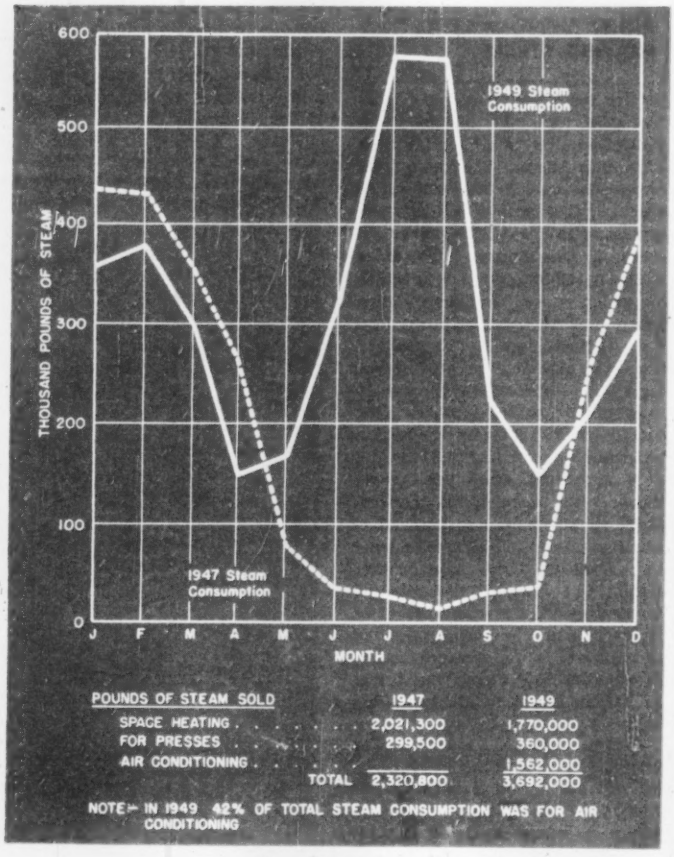
THE COMMITTEE has not found any two cities exactly alike with regard to their air pollution problems. The extent to which a city is bothered by air pollution depends on many contributing factors: Much equipment is frequently obsolete and overloaded; more is mechanically defective; its design and installation leaves a lot to be desired; carelessness and indifference in operation contribute much to the pollution problem in most cities. Likewise, topography, and weather; the location, concentration and type of industry; as well as other important factors, some political some economic, influence the problem.

In Philadelphia the problem is one of smoke from refuse burning plants and dumps, oil fired plants improperly operated, fumes and smoke from metal smelting and refining plants, smoke and air pollution from oil refineries and fly ash from hundreds of coal fired plants already mechanized.

Toronto has smoke and pollution from hundreds of commercial and small industrial plants using obsolete and mechanically defective equipment, much of which is overloaded. Many other sources of pollution can be traced to foundries, special process plants and the railroads, over which the smoke control department has no jurisdiction.

The problem in Pulaski, Va., is due chiefly to burning of wood and refuse materials while Charleston, W. Va., has a smog problem which results from processes peculiar to the chemical industry. In Pittsburgh, we find the problems connected with heavy industry, such as steel, with its own problems of fumes, dust and smoke. Last but not least there is the problem with which Los Angeles has to contend. It has been so well publicized that it requires no repetition here. These and a hundred other examples readily indicate why no two cities are alike and why corrective measures in a specific city cannot be made except by those qualified and familiar with the facts. The public is just beginning to have some appreciation of the many factors involved.—H. B. LAMMERS, chairman and director of engineering, Coal Producers Committee for Smoke Abatement.

**Steam consumed for air conditioning a small department store amounted to 42 percent of the total for the year. The 1947 curve is before air conditioning and the 1949 curve after installation of steam operated absorption air conditioning**




| POUNDS OF STEAM SOLD | 1947 | 1949 |
|---|---|---|
| SPACE HEATING | 2,021,300 | 1,770,000 |
| FOR PRESSES | 299,500 | 360,000 |
| AIR CONDITIONING | | 1,562,000 |
| TOTAL | 2,320,800 | 3,692,000 |

NOTE:— IN 1949 42% OF TOTAL STEAM CONSUMPTION WAS FOR AIR CONDITIONING

## VISIBILITY REDUCTION FROM MAN-MADE POLLUTION

BY COMPARING the visibility at Los Angeles with that at other locations both north and south, it was possible to establish that on days of low humidity, the man-made pollution contributed about 90 percent of the particulate matter that was responsible for poor visibility. An analysis of the atmosphere in Los Angeles showed that it may contain from 30 million to 600 million particles per cu ft. These particles were classified into five general types, the amounts of which vary markedly from time to time and produce a corresponding variation in their effects on visibility. The five types are:

1) *Carbon and metal particles.* These are black, opaque particles occurring in clumps or aggregates. They are responsible for from 10 to 50 percent of the decrease in visibility.

2) *Transparent, light-scattering crystals.* These water insoluble particles, including aluminum oxides and silica, account for from 10 to 30 percent of the decrease in visibility.

3) *Small, water soluble and oil soluble particles and oil droplets.* Effect on visibility is not known, but believed to be small.

4) *Substances capable of forming moisture droplets in the air.* The principal one is sulfur trioxide, which forms droplets of sulfuric acid on contact with atmospheric moisture. This group of substances accounts for from 5 to 20 percent of the decrease in visibility.

5) *Large soluble crystals.* Sulfates, nitrates and chlorides. They account for from zero to 80 percent of the decrease in visibility.

By studying the optical effects of the particles in the atmosphere, it was possible to establish that most of them were approximately 0.3 to 0.4 micron in diameter. By measuring the visibility by a photographic photometer method it was possible to obtain an objective measure and record of visibility. By collecting, counting and measuring the particles in the atmosphere it was possible to calculate the visibility reduction brought about by these materials and thus verify from the visibility measurements that the particles collected for analysis were present in sufficient quantities to account for the effects observed.—PAUL L. MAGILL and R. W. BENOLIEL, Stanford Research Institute.

## STRIVE FOR HIGHER HEAT PUMP COP's

IN THE DEVELOPMENT of a new or different idea such as the heat pump it is well to review our progress occasionally in terms of the ultimate possibilities open to us. Why is our development progressing along one particular direction? Are the factors which influence a particular trend in design always valid? It has been frequently pointed out that heat pump and refrigeration equipment are basically one and the same thing, with the implied conclusion that 50 years of refrigeration theory and experience can be applied equally well to this newer application.

It would seem that this is an over-simplification of the situation. This may explain why the development of heat pump systems in this country to date has apparently consisted of first starting out with a production model of a refrigeration or air conditioning compressor and then modifying it in such a manner as to make it serve as a heating machine.

We use refrigeration machinery because that is the only way we can produce low temperatures, and we accept the coefficient of performance inherent in this machinery. However, the heat pump as a heating machine will always be in competition with other heating systems. The economic possibility of its development to a position of real commercial importance will depend to a large extent on how high its operating coefficient of performance can be raised above unity.

With the increasing interest shown in the heat pump and the large amount of activity centered in its development, it seems destined to become an important and widely used type of heating system. This conclusion is further emphasized by the fact that the concept of the heat pump is logical and fundamentally sound. Its widespread acceptance will result in a valuable contribution to public welfare through the conservation of our natural energy resources.

To realize a maximum usefulness there must be a constant striving for higher coefficients of performance, and in this respect there should be a full appreciation of the inherent limitations of the vapor compression cycle and its prototype, the Carnot cycle.

Experience shows us that the practical way to build a heat pump is as a steady flow apparatus in which heat is pumped from a fluid such as well water, falling in temperature, to another fluid such as circulating room air, rising in temperature. For example, a typical condition of operation might be a heat pump heating air from 70 F to 125 F by cooling well water from 50 F to 40 F. The ideal Carnot COP for this operating condition would be about 6.88. With thermodynamics we can show, however, that it is theoretically possible to reach a COP of approximately 10.71, under these operating conditions, which is over 50 percent greater than the Carnot. The percent improvement over the ideal simple vapor compression cycle would of course be appreciably greater than this.

With this attractive and significant area for improvement theoretically possible, and in view of recent new developments in related equipment, we would do well to reexamine other cycles, most notably the various air cycles, for a possible practical approach for widening our horizons in this field.—JOHN F. SANDFORT, associate professor of mechanical engineering, Iowa State College.

## REPORTS ON 1949 CONSTRUCTION MATERIALS

PRODUCTION OF construction materials in 1949 was approximately 8.5 percent lower than in 1948 despite a 3 percent increase in new construction put in place in 1949, according to the U. S. Department of Commerce.

The department's composite index of production of selected construction materials for 1949 was 132.7 (1939 monthly average is 100) compared with 145.0 for 1948 and 139.6 for 1947.

New construction put in place in 1949 totalled $19.3 billion to exceed the 1948 total by 3 percent.

# Temperature Dominates Mankind

TEMPERATURE bears an importance to man far beyond the mere matter of his hour-to-hour comfort. In some places it lays a heavy, stagnating hand over his life and holds him to a vegetative existence; in others, it generates an energy and progressiveness which drive him forward with irresistible impetus. Its effects begin even before he is conceived, for the metabolic vigor of parental germ cells at the time of their union exerts a potent influence over the entire course of the new life. Without favorable temperatures, neither individual nor nation can develop innate potentialities to the full.

The hand of temperature is being felt over the world today, much as Ellsworth Huntington so ably pictured its course through past centuries. We are now in one of the long cycles of climatic change that alter the courses of nations and of world trends. Man thus has urgent need to understand the mechanism of this temperature dominance over him as an individual and over mankind as a whole.

The human body is essentially a combustion machine that functions only as its cells release energy by burning the foodstuffs taken in. True, this combustion in the cells is a very complicated affair, carried on at low temperatures and in numerous independent steps through the aid of special catalysts. Although it is far less violent than the gasoline explosions in an automobile motor, its overall efficiency is no greater, and it is even more dependent upon rapid dissipation of its waste heat.

For every unit of combustion energy transformed into work output by our bodies, three or four similar units must be dissipated as waste heat. Failure of such dissipation to keep pace with heat production in the body may mean heat stroke and death within a few hours. The waste heat of combustion thus becomes one of the body's most important excretory products.

Sudden changes in external temperatures, or in the rate of heat production within the body, are quickly countered by the movement of more blood into or away from the skin and by the activity of the sweat glands. The body can thus meet short-term emergencies with only slight changes in its internal

temperature or behavior characteristics. External heat or cold, prolonged through many weeks or months, however, induce basic and important changes in the body economy.

Following several weeks of difficulty in dissipating waste heat, physical and mental activity declines, and there is a drop in the combustion rate. Some of the glands of internal secretion, which so largely influence combustion rate, go into a less active or resting, state. This is particularly true with the thyroid, adrenal, and sex glands—probably also with the pituitary. A lowered total combustion rate means less energy for thought and action, as well as less waste heat to be dissipated. Physical and mental characteristics thus change from the dynamic and pushing to a more passive "let-George-do-it" type. Personal initiative gives way to a desire for security.

That these are basic changes in the individual's metabolic make-up is evidenced by equally profound alterations in such body functions as growth, rate of development, resistance to infection and thought capacity. When difficult heat loss induces a lowered combustion rate in the cells, growth slows down and may be completely halted, even though an ample food supply be available; onset of puberty and maturity is progressively delayed, and ability to reproduce is reduced or completely obliterated, although matings go on freely; resistance to bacterial invasion is impaired, especially for those respiratory infections in which the white blood cells provide the first and main line of the body's defense system; and, finally, ability to solve problems is greatly impaired.

Proper ease of body heat loss means just the opposite— a fast growing, early maturing, highly fertile individual, with a keen mentality and good ability to fight infectious disease. These statements are by no means hypothetical but are based upon well authenticated statistical findings on man and on experimental animals under controlled conditions. They show up in the laboratory, under natural climatic differences, and during the wide seasonal swings in middle temperate latitudes.

Half of the earth's population lives year after year under a depressive blanket of moist heat that makes impossible an active life or high vitality. Children grow slowly, mature late, and are, in the main, of inferior stature. Although the birth rate is high because of lack of restraint, high stillbirth and infant mortality rates cut heavily into the ranks of those who might live on to adulthood. Infectious diseases are the chief causes of death at all ages. The menses come on 1½ to 2 yr later than among girls of cooler climates, and reproductivity fertility shows an even greater lag. The age-old fallacy of early tropical maturity should be abandoned—it probably represents a carry-over from the Ice Age of 20,000 years ago, when optimal temperatures for man were to be found only in what are now the tropical regions.

### Summer School Folly Without Conditioning

Loss of mental acuity constitutes perhaps the most disturbing phase of heat effects, when viewed from the standpoint of the general welfare of mankind. Some years ago, Ellsworth Huntington collected statistics showing best mental function at 38-40 F, whereas 64 F seemed optimal for physical performance. Today we know that college students, given the standard aptitude or intelligence tests at Cincinnati latitudes across the country, achieve ratings only 60 percent as high in summer heat as in winter cold. No such seasonal contrast in ratings occurs in the northern tier of states, where there is no prolonged depressive summer heat. White rats have further confirmed the folly of summer sessions in colleges at lower latitudes unless the students be air conditioned.

Difficulty in body heat loss begins its dominance over any person's life even before he is conceived. The metabolic vigor of parental germ cells at the time of their union exerts a considerable influence over the whole life course of the new individual. Those children at Cincinnati latitudes whose parents have been depressed by July and August heat before conception have just half the likelihood of entering college that is enjoyed by those conceived in winter cold. Those conceived in summer heat also grow more slowly, develop later, and live a shorter life span (over four years less, according to Huntington.)

Further handicaps of hot weather conception include a low likelihood of inclusion in Who's Who and of being president of the United States. Eleven of our presidents were conceived in the first quarter of the year, ten in the second, four in the third, and seven in the fourth. Only one August conception has been at the head of our government. In any field of accomplishment one investigates, the advantages of cold weather conception stand forth in bold relief.

Proper ease of body heat loss may be essential to progressiveness and accomplishment, but its advantages are by no means free of hazards. Evidences of mental and physical breakdown are today most alarming in those regions of the earth where temperatures are most energizing. Arteriosclerosis and heart failure, diabetes, cancer and many other breakdown diseases are there claiming far more victims than in tropical warmth, where infectious diseases run rampant. Perhaps some day air conditioning will provide us all with the "golden mean."

We pride ourselves upon our scientific achievements and the conquest of disease by Men of Medicine; yet months or years of unseasonable warmth bring devastating economic downturns against which we have found no defense, and at such times sickness and death rates decline, even while our physicians are least busy.

*CLARENCE A. MILLS, Ph.D., M.D., of the Laboratory for Experimental Medicine at the University of Cincinnati, is widely known for his studies of and writings on the effect of climate on man. He explains here that "temperature bears an importance to man far beyond the mere matter of his hour-to-hour comfort" and that, without favorable temperatures, "neither individual nor nation can develop innate potentialities to the full." He suggests that perhaps some day air conditioning will provide us all with the "golden mean" of climate*

Statistically, one might say that people are better off the less they see of a doctor, but in reality it is the lessened storminess and reduction in bodily stress that account for the health betterment in hard times.

Up through the milleniums since the last Ice Age, the crest of human civilization has shifted farther and farther poleward, with irregularly rising earth temperatures and melting ice caps. Improved housing and greater protection against winter cold have been considerable factors in this poleward shift, but probably of greater effect has been the expanding region of tropical heat.

Through the last 10,000 years of the earth's history, cyclic changes in temperatures have left fairly clear records. A millenium of rapidly receding glaciers and polar ice caps was succeeded by one of stability or advance. Five such cycles are in evidence over the last 10,000 years of rapid Ice Age regression. The next-to-last cold millennium fell in the days of early Greek and Roman glory and was followed by the thousand years of Dark Age warmth, when cereal grains could be ripened in Iceland and grapes in England.

The peak of Dark Age warmth occurred about A.D. 850, when optimal temperatures in far northern Scandinavia activated the Norsemen and Vikings into a century of exploration and settlement. The gradual return of benumbing cold to their homeland and to the Greenland and Iceland settlements from the 10th to the 14th centuries dimmed their glory. Central Europe was at the same time relieved of her enervating warmth and entered the Renaissance and the period of industrialization. The miracles of this Western mechanistic civilization have reached a peak in America during the past century.

Once again earth temperatures are surging irregularly upward, reaching levels in 1930 about as high as prevailed a thousand years earlier. During the warmth of the early 30's soil thawing in Greenland allowed excavation of Viking bodies that had lain in solidly frozen earth for a thousand years. Available records indicate that earth temperatures have been rising for a full century, bringing definitely milder winters and the long summers of depressive heat that sap human energy and change the course of nations. The same semitropical lethargy which earlier engulfed the Mediterranean countries of Europe is today creeping northward over the United States and Central Europe.

The effects of temperature will go far beyond their present influence over individual life and national trends. The present millennium of warmth may witness complete melting of the polar ice caps and consequent profound changes in the climates of present polar and temperate zones. The earth has experienced long eons of freedom from polar cold during past periods of interglacial warmth, and Brooks, in his book, Climate through the Ages, pictures the present ice caps as being down to the critically small diameter that makes them susceptible to rapid disappearance. Anyone desiring to make use of this information for long-term investment in northern real estate should buy high land, however, for the ocean level will rise roughly 150 ft as the ice caps disappear.

It takes only a few degrees of change in mean annual temperature to produce striking climatic alterations. Dark Age temperatures of Scandinavia, Britain, Iceland and Greenland, for instance, were probably only 4 to 5 deg higher than those prevailing through the colder centuries since the time of the Renaissance.

Much study and speculation have centered around the possible causes of these shifts in earth temperatures. The regular seasonal cycles are, of course, known to be based upon the changing inclination of the earth's axis with respect to the sun. Variations in sunspot activity and in the intensity of solar radiation to the earth have also been correlated with periods of unseasonal cold or warmth. Sudden outbursts of sunspot activity are accompanied by increased heat and magnetic radiation to the earth but are soon followed by greater storminess and low temperatures in temperate latitudes.

During the declining or low phases of sunspot activity in the major 11 yr cycles of the last two centuries, two-thirds of the months have shown unseasonal warmth, while unseasonal cold has accompanied rising or high sunspot activity two-thirds of the remaining time. We may tentatively accept the sunspots and the changes in solar radiation as a direct cause of weather shifts and of periods of unseasonable warmth and cold through the years. Whether the same influence lies behind the 2000 yr cycles, and the Ice Ages and alternating Inter-Glacial Stages, still remains a matter of conjecture.

Sunspots are thus a matter of profound concern and have prompted investigations into the causes lying behind climatic fluctuations. As a result, we now know that each of the major planets of the solar system tends to depress sunspot activity on that part of the sun's surface exposed to the given planet. Observations have shown that sunspot activity decreases on any segment of the sun's face exposed to the earth during half of the sun's 28 day rotational period and increases on the opposite side during the other two weeks. Tides in the sun's gaseous mass have been believed to result from the varying planetary pulls, but there is also a possibility that other heavenly bodies may also exert potent influences.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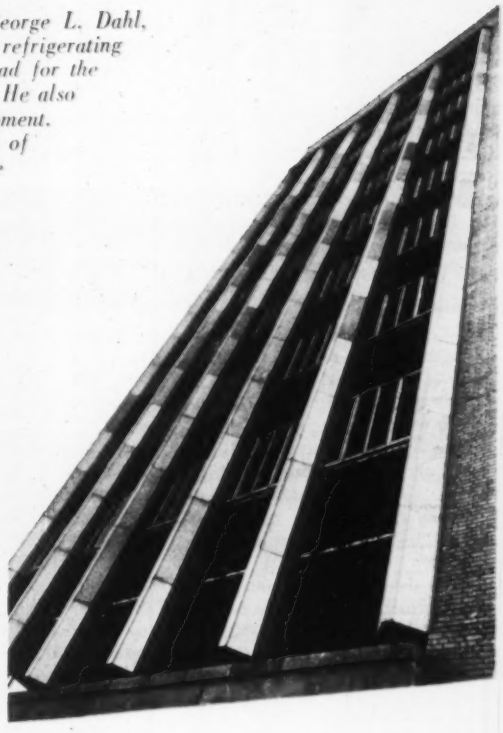
*H. C. GREGERSON, chief mechanical engineer, George L. Dahl, architects and engineers, tells why steam absorption refrigerating units were selected to handle the air conditioning load for the new Employers Insurance building at Dallas, Texas. He also explains briefly the principle of this type of equipment. An interesting feature of the construction is the use of the vertical fins on the outside of the building to house the pipes and ducts which convey the heating and cooling for the exterior zones of the building*



Employers Insurance building is a 14 story and basement structure sheathed in aluminum and glass with the lower store fronts being of limestone and granite and the uppermost and rear sections of cream colored brick. The vertical aluminum fins which stretch up three sides of the building would hardly be thought of as an essential part of its air conditioning system. However, they actually conceal the pipes and ducts which carry the heating and cooling for the exterior zones of the building, and are insulated (Photo by William Langley)

# *Steam Absorption Refrigeration* Air Conditions Dallas Building

STEAM ABSORPTION refrigerating units are strong contenders for honors in the air conditioning field where fuel is relatively cheap or steam is already available; this is indicated by an analysis made in designing the air conditioning system for the Employers Insurance building, Dallas, Texas. The three units rated at 150 tons each being used in this building will be among the first jobs of this type installed. Two other such installations in Dallas are nearing completion and there are several others in the southwest being put in or in operation, but the number is not as yet very great.

Before final arrangements were made for the construction of the Employers Insurance building, the subject of refrigerating equipment was investigated thoroughly. Data were obtained from many sources in order to have a conclusive analysis of the various refrigerating machines. Types of refrigerating equipment considered were the conventional motor driven centrifugal compressor, the turbine driven centrifugal compressor, and the steam absorption refrigeration system.

After thorough investigation, it was found that the initial cost of two motor driven centrifugal compressors would be the least, three steam absorption units next, and two turbine driven centrifugal compressors the most expensive. The steam absorption units were found to be about 10 percent higher in initial cost than the motor driven machines, and the turbine driven units were found to be about 15 percent more expensive than the motor driven machines.

These costs included all equipment affected by the refrigerating equipment. Larger cooling towers had to be considered for both the absorption and turbine units. In both cases, however, the electrical installation costs were less.

While the cost data compiled showed that the motor driven centrifugal compressors were lowest in initial cost, *it should not be taken for granted that these conclusions*

*will follow in other applications.* Should there be an existing source of cheap steam, it is very possible that both the steam absorption units and the turbine driven units would be cheaper in initial cost than the motor driven centrifugal compressors. There are too many factors to be taken into consideration in a cost analysis of this type to assume that the one made for this job would fit other jobs.

### Original Cost Not The Only Factor

Original cost is not the only factor to be considered in selection of equipment. In determining the operating costs of the three types of systems, it was found that the steam absorption units would be cheaper to operate than either of the other two—in fact, sufficiently cheaper to warrant their use. Because of the initial cost of the turbine driven centrifugal machines, which included the cost of high pressure boilers, the analysis resolved itself into a comparison between the motor driven centrifugals and the steam absorption units.

This analysis showed that the yearly operating expense for the steam absorption units would be approximately 35 percent less than that for the motor driven centrifugal machines. Because of this lower operating expense, enabling the equipment to be amortized in a shorter length of time, it was decided the steam absorption units would be used in the building. It was estimated that the absorption units would save enough in operating costs in five to eight years to pay the difference in initial cost.

Another advantage in favor of the steam absorption units is the decrease in weight. While they require a cooling tower heavier than that usually needed, the units themselves weigh less than half that of a more conventional unit.

### Steam Absorption Principles

The fundamental simplicity of the steam absorption unit is quite startling. A combination of principles known to man for many years is employed. The unit itself, with no moving parts, and the accessories are items of equipment which present no unusual maintenance problems.

A common physics experiment is to place a small amount of water in a watch glass under a bell jar and exhaust the air from the jar. As the pressure in the bell jar approaches absolute zero, the water in the middle of the watch glass boils while the water at the extremities of the watch glass will form flakes of ice.

Two steps have been added to this fundamental principle in order to form the low side of the absorption refrigerating system. The first is a pump capable of operating at extremely low pressures that circulates the chilled water to the various pieces of equipment using chilled water and, of course, back to the evaporator to be re-used. The second is the use of lithium bromide, an extremely absorptive material.

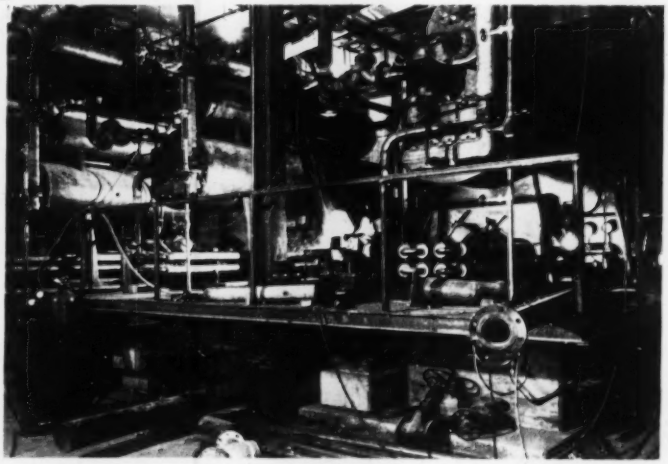
The cooling process takes place in the lower of two cylinders, called the absorber-evaporator. In order to obtain maximum water surface, the water that is returned for cooling is sprayed into a pan at the top of the absorber-evaporator. The very low absolute pressure and vapor pressure in the chamber causes the water to evaporate. Inasmuch as the heat of evaporation is gained from the water itself, the water temperature is lowered the required amount.

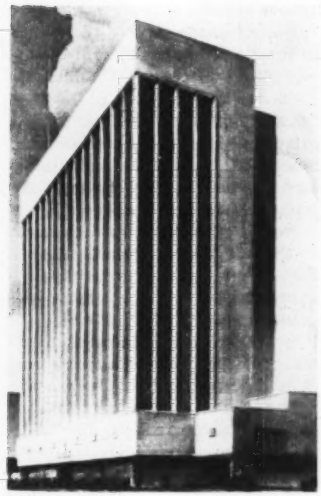
As can be readily seen, as the water boils, lowering its own temperature, there must be a means of evacuating the vapor which forms. The lithium bromide solution, which provides this means of evacuation, becomes steadily weaker as it absorbs the water vapor. This weakened solution is pumped to the upper of the two cylinders, the condenser-generator, where it is regenerated. This part of the equipment is also maintained at very low pressures.

Low pressure steam provides the motive power for strengthening the liquor by boiling off excess water and concentrating the salt solution. Here again, the problem of condensing the vapor exists. Condensation takes place in a pan in the upper section of the condenser-generator. Water supplied from the cooling tower condenses the vapor which is returned to the evaporator where it is re-used in the cooling cycle. As water is boiled off the lithium bromide solution, it becomes stronger and is returned to the evaporator, where it starts the cycle over again.

Accessories include a purge condenser to remove air from the system, a heat exchanger to remove heat from the strong solution as it is returned to the chiller, an eductor for mixing the strengthened solution and the solution taken from the chiller to provide more efficient removal of heat from the strong solution, steam ejectors for removing air and non-condensables from

**Construction view of the steam absorption units. The cooling process takes place in the lower of two cylinders—the absorber-evaporator—and the solution is regenerated in the upper cylinder—the condenser-generator (Photo by William Langley)**





**Three steam absorption refrigerating units with a nominal rating of 150 tons each were selected for air conditioning the building. As is becoming fairly common in the southwest, the refrigerating equipment is on one of the top floors of the building (Photo of a rendering made by George L. Dahl, architects and engineers)**

the evaporator and condenser and, of course, controls for the regulation of capacities.

### Installation of Absorption Units

As is becoming fairly common in the southwest, the refrigerating equipment is on one of the top floors of the building, for it was decided in the early design stages that space in the basement was too valuable to give up for a machine room. For the type of heating and cooling planned for the building, this did not impose any difficult engineering problems. A small amount of space is gained throughout the building itself because no bulky stacks go up through the building. Also, there are no condenser water pipes to take up space.

Because extremely low pressures are required in the evaporator and condenser, it is absolutely necessary that all parts of the system connected to them be absolutely airtight. If pump glands or other parts are leaky, the effectiveness of the equipment is nullified to a great extent as a small leak will cause a large reduction in unit capacity. Special pumps and valves are used with these units in order to prevent air leaks into the system.

The valves used are a diaphragm type in which there is an absolute physical barrier between the inside and outside of the valves. These valves are necessary only on the top two floors of the building, inasmuch as the effect of the vacuum produced could not possibly be more than that of a column of water equal to 29 in. of mercury. Piping to the units is so arranged that one, two or three units in any combination can be used at any time. This is accomplished simply by valving off the unit to be taken out of service.

### Capacity and Control

The calculated cooling load for the building is approximately 400 tons. This necessitated using three absorption units, each capable of handling approximately 135 tons. Earlier in this article, it was stated that these machines had a nominal capacity of 150 each. However, that capacity is for producing water at a temperature of 46 F. The requirement for the type of system designed was for water at a temperature of 42 F. As can readily be seen, the tonnage of the unit varies according to the temperature of the water being used. As is the case of the reciprocating or centrifugal refrigerating compressors, the efficiency of the unit decreases with a decrease in water temperature. Because of the type of system being used for cooling the exterior zones of the building, it is essential that relatively cool water be used in the cooling processes.

A thermostat in the water line leaving the chiller regulates a valve in the discharge of the solution pump. This reduces the amount of absorbent circulated, thereby reducing the capacity of the unit. With a reduction in the amount of solution circulated, the temperature of the solution leaving the generator rises. A thermostat in the solution line sensing this rise in temperature throttles a steam valve to the generator. The steam supplied to the generator because of this regulation varies in proportion to the load.

About the only serious cause of possible shutdown of the equipment is solidification of the solution, due to failure some place in the equipment. There are ample safety controls to protect against this happening. Should this occur in spite of the safeguards, it can be corrected in a few hours without special equipment.

### Wide Range of Control

Each unit has varying capacities from approximately 10 percent of its full capacity up to its full rated capacity, which gives a wide range of control.

The Employers Insurance building, owned by the Texas Employers Insurance Association and Employers Casualty Co., has been built from plans and specifications drawn by George L. Dahl, architects and engineers. James Stewart and Co. handled the general contract work, and the C. Wallace Co. installed the mechanical equipment in the building.

### "QUOTE"

"Strangely enough, the optimum indoor winter temperature has increased appreciably in recent years. Research on this subject conducted about 25 years ago indicated an optimum effective temperature of 66 deg, which would be equivalent to 70 F dry bulb at 50 percent relative humidity. Today, both laboratory research and field observations indicate an optimum dry bulb temperature of about 75 F, and this temperature seems to hold over a fairly wide range of relative humidities.

"The primary reason for this upward trend in comfort level is probably to be found in the lighter clothing being worn today by both men and women. It is also probable that, as heating methods and techniques have improved, the American public has lost some of its Spartan complex, and has become more exacting in its demands with regard to space heating."—C. M. HUMPHREYS, senior engineer, G. V. PARMELEE, research associate, and CYRIL TASKER, director of research, ASHVE Research Laboratory, at a conference on Weather and the Building Industry sponsored by the Building Research Advisory Board.

# Dehumidifying Air for Dry Blast in Steel Production

*JOHN EVERETTS, JR., of the office of Charles S. Leopold, consulting engineer, has had a wide experience in industrial dehumidification work. He contributed a paper on dehumidification of air for dry blast to the process industries conference of the American Society of Mechanical Engineers at Pittsburgh last month, from which the following remarks have been excerpted*

THE DETRIMENTAL EFFECT of moisture in blast furnace air was recognized in the steel industry over 100 years ago, but mechanical difficulties made the method used prohibitive. Because of the development of better refrigeration equipment and other methods of removing moisture from the air through the growth of the air conditioning industry, dry blast was again revived in the late 1930's. From then until the beginning of World War II, approximately 50 installations were made, of which about 20 were for large blast furnaces and the balance for open hearth, crucible and alloy steel furnaces.

The results obtained in increased production and reduced fuel costs, maintenance and operating costs and the degree to which the moisture level should be maintained are subjects of controversy which can be argued by mill operators until the end of time. Some mills show an increase in production as high as 22 percent and a fuel saving up to 16 percent. Others claim an increase of only 5 percent with a corresponding reduction in fuel. Maintenance and operation are dependent entirely upon the ability of the maintenance superintendent and are reflected in the general maintenance of the mill. Operating costs are predicated upon the particular type of bookkeeping system currently used, and no two mills are alike in this respect. Operating costs of dry blast systems may vary from zero (because waste heat and power are used at no book value) up to 30¢ per ton of pig iron because power and heat are charged on a basic rate set up by management. The degree to which moisture level should be controlled is set at 1 grain per cu ft of air by one group and three grains by another group. There is still a third group of operators (although in the minority) who do not believe in any moisture control at all.

### Theoretical Saving Possible

Theoretically, the removal of 1 grain of moisture per cu ft of blast furnace air will result in a saving of 41 lb of coke per ton of pig iron, due to reduced moisture-dissociation energy loss. For a thousand ton *per day* furnace and with a moisture reduction from 6 to 3 grains per cu ft of air, the saving would

be approximately 61.5 tons per day, or about 7 percent. If the moisture removal were from 6 grains to 1 grain per cu ft, the saving would theoretically be increased 12 percent.

In addition, there would be an increase in pig iron production, due primarily to the uniformity of operation of the furnace and the ability to operate the furnace nearer to its peak production capacity and maximum efficiency because of the elimination of the moisture variable. The control of the moisture content, regardless of the level, tends to result in a more uniform silicon content and a more uniform grade of iron.

The prime function of any dehumidification system is to remove moisture from the atmosphere at minimum operating costs, investment, maintenance and breakdown hazard. Table 1 is presented to show the relative moisture removal by the month to maintain a condition of 1 grain per cu ft, or 3 grains per cu ft, for the Pittsburgh area. It has been assumed that with any weather conditions under either case, the air will be used as is and no moisture added to maintain a constant minimum.

It can readily be seen from the table that it requires 2.6 times as much work to bring the atmospheric moisture content to 1 grain per cu ft as it does for 3 grains. The evaluation of the moisture level to be maintained is entirely dependent upon initial cost, operating costs, maintenance, and depreciation rate, all balanced against increased production and reduced fuel costs.

### Four Methods Used

There are four general methods for removing moisture from blast furnace air (mechanical refrigeration, absorption refrigeration, solid sorbents, liquid sorbents). Each of these methods may be used in a precompression or post-compression system. Although the post-compression system may appear more efficient, because it is easier to remove moisture at 20 psig than at atmospheric pressure, it presents so many disadvantages from a design and maintenance standpoint that it can be relegated to the "nice to have met you" category. If the blowing engines are of the reciprocating type, the pulsations will be damaging to any cooling coils. Any oil or dirt carried over by the air will clog coils or ruin any sorbent materials, which means a bypass with valves to permit maintenance without shutdown.

**Table 1—Tons of water removed from 80,000 cfm from atmospheric conditions to conditions indicated**

| Maintained moisture | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 gr/cu ft | 178 | 117 | 178 | 370 | 662 | 1070 | 1140 | 1045 | 930 | 512 | 302 | 178 | 6682 |
| 3 gr/cu ft | 0 | 0 | 0 | 30 | 204 | 570 | 630 | 560 | 452 | 97 | 11 | 0 | 2554 |

The precompression system—that is, treating the air before it enters the blowers—is the more accepted method because of accessibility of equipment and easier maintenance and repair.

[In his ASME paper, Mr. Everetts here describes equipment used in the four general methods for removing moisture, and includes data on their electric, steam, gas and water requirements. In conclusion, he states that "dehumidification of air is no longer an experimental problem. The dewpoint can be controlled within a fraction of a degree with equipment which will operate as long and as efficiently as good practice dictates. When the mill operator decides what he wants, the air conditioning industry will be able to provide the requisite system design, as well as equipment which has been proved in the field. Control of moisture in blast furnace air removes one of the many variables in the production of steel. If the other blast furnace variables could be controlled as easily, the life of a mill operator would be much happier."]

## INSULATION PACKAGES BANK OF PIPES

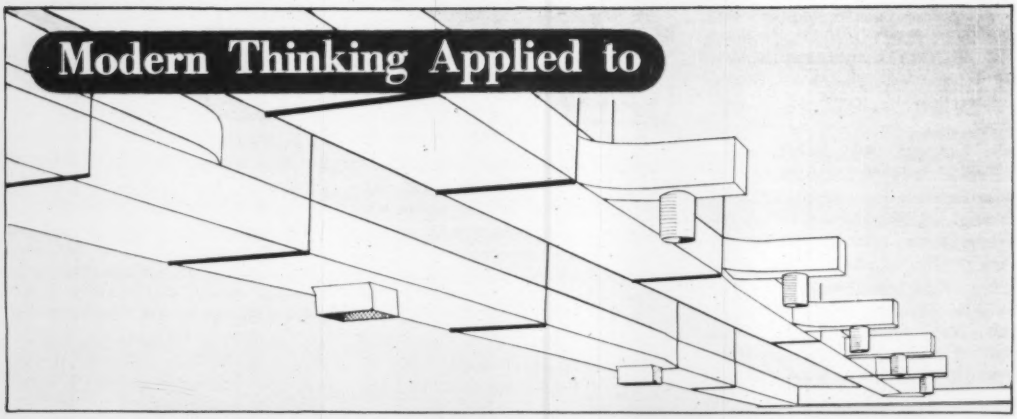
A CHEMICAL manufacturer, when insulating a parallel bank of high temperature steam lines leading from a waste heat boiler to an overhead distributor drum, insulated the entire bank as a unit and eliminated the necessity of insulating each pipe individually. This saved installation time, thus reducing costs, and made it possible to complete this phase of the overall job without ordering special pipe insulation. Mineral wool blankets and mineral wool insulating cement were used on this section of the job as well as for insulating large diameter ducts, heat exchangers, economizers and converters.

The blanket application was completed in two steps. First, 1 in. thick mineral wool blankets, with wire mesh backing on both sides, were wrapped around the entire bank of pipes and secured in place with $\frac{1}{2}$ in. galvanized bands on approximately 8 in. centers. The blankets were butted tightly together and laced with wire through the edges of abutting mesh.

Second, a $\frac{1}{2}$ in. coating of mineral wool cement was troweled over the blanketing to provide a tightly sealed, neat appearing exterior. It was a simple matter to trowel the cement in place over the wire mesh blanket covering.

This same technique can be used outdoors, although thicker blankets are generally required due to seasonal temperature variations and greater average air movement over the surface. A coat of $\frac{1}{4}$ in. thick asphaltic weatherproofing with galvanized wire netting as reinforcing should be applied over the insulating cement.

# Modern Thinking Applied to



# DUCT DESIGN

*KIRBY WALKER draws upon his experience in the heating and ventilating field and in wartime research and engineering to discuss duct design. A licensed professional engineer, he was engaged on heat transfer and combustion projects for two large aircraft companies during the war. He has had a wide experience in the heating and ventilating industry, and has supervised manufacturers' laboratory and development personnel*

ONE OF THE beliefs to which I take exception is the objection to wide, thin ducts. In certain reference books there are statements to the effect that a duct should not be wider than, say, six times its thickness.

### Use of Wide, Thin Ducts

I have personally built and tested ducts much more extreme than this and am familiar with the test data correlated and currently used to furnish pressure loss charts and other published data. If the theory that comes from correlated test data is correctly understood, such ducts obey the rules and their performance may be easily predicted. This applies to ducts of 50 to 1 proportions as readily as to round ones, and to very small dimensions—say a duct $\frac{1}{2}$ in. by 25 in. in section.

Evidently, such small ducts have given trouble on jobs. One can readily appreciate this and realize that replacing it with another different duct might cure the trouble. I don't deny the evidence—I doubt the explanation. Let us therefore see how such a case might occur. (It is realized that a thin duct requires more sheet metal per cfm carried, but that isn't the question here.)

The misunderstanding may be in the use of elbows. Many use a "diameter radius of $1\frac{1}{2}$." This is only for an ell with an aspect width of more than 0.80. Designers drawing flat ducts in the plane of a drawing often swing them around with a diameter radius of $1\frac{1}{2}$ and forget they have an aspect width less than 0.80 and a presure loss two, three or more times greater than if a square or round duct were being drawn.

I have run across straight flat ducts in which partitions had been placed, in an attempt to break them into a series of square ducts. If the pressure loss is figured two ways, using the same quantity of air but with the partitions and without, it will be seen that such partitions increase the loss.

If partitions are put in the ells, the aspect width is brought above 0.80 and the loss is so reduced. Partitions are all right in ells but not in straight pipe.

For a given velocity, the coefficient $f$ is greater in smaller ducts. Could it be that someone, using the same velocity in small pipes as in larger ones, thought the $f$ coefficients were the same? In going from a square duct to a thin duct and selecting one for "equal friction" the velocity is reduced. Could it be that in going from the stout to the thin duct, the transition was made so that the drop in velocity

caused a loss? Another possibility is that small ducts are taken off others carelessly and large ducts are more carefully designed. It is quite apparent that if one obeys and understands the rules, small and thin ducts, those even less than 1 in., will perform as planned.

### Presentation of Design Data

Equal pressure loss charts show rectangular ducts with losses equal to given round ducts. When a duct with a smaller dimension is selected for equal pressure loss, one with a lower velocity is picked. This introduces differing velocities close together in the system—sometimes right at a branch connection. In my opinion, these charts and their use are a needless complication.

All friction data should be presented as $f$ or $f'$ vs. $R.N.$, in my opinion. We now have the straight pipe data presented that way. One chart could present several types of obstructions, a line for each. This could include several entrances, enlargements, etc. Another would be one on orifices. Another chart could show a line for each typical ell.

In designing, the $R.N.$ of the duct or obstruction is at once apparent and the $f'$ value could be picked off the chart, interpolating if necessary for various diameter ratios, $d/D$.

### Summary of Suggestions on Duct Design

There are several points which have been brought out in these articles on duct design which I hope the reader will find helpful. Those which have been presented are:

1) Pressure loss or friction is some fraction $f'$ or $f$ of the velocity head, $q$. So, for obstructions, we have $h = q\,f'$ and for straight pipe, $h = q\,f\,L/D$.

2) $f$ and $f'$ are friction coefficients. They are plotted against Reynolds number.

3) $q$, the velocity head, is, for air, the square of the quotient of the fpm divided by a constant.

4) The equivalent diameter of a duct, $D$, is between once and twice the narrowest dimension in feet.

5) The Reynolds number of a duct or opening through an obstruction makes it possible to pick $f$ off a chart. For 70 deg air, $R.N.$ is the product of 105, the fpm, and the equivalent diameter.

6) For straight ducts, two lines on Fig. 2 [p. 87, March 1949 HPAC] are sufficient to give $f$ for practical purposes. One line is for round and square sections, the other for flat annular sections.

7) A simple radius ell of $(CR) = 0.5$ and $(AW) = 0.8$ or more, has an $f'$ of 1/7. For shorter curve radius or an aspect width less than 0.8 due to space limitations, elbows with vanes may be picked from Fig. 6 [p. 93, May 1949 HPAC] and Fig. 9 [p. 94, May 1949 HPAC] with $f'$ running from 1/7 up to ½ and higher.

8) Pressure loss is loss of total pressure and a complete picture of pressures may be presented and analyzed by means of pressure gradients.

9) Converging obstructions, reductions in area, are not likely to give the high losses found when area increases and duct construction diverges in the direction of flow.

10) Distribution in a converging connection, as at an exhaust grille, is better than at a diverging connection, as at a supply grille.

11) Flush takeoffs smaller all around than the main duct have good distribution but a high friction. A well designed takeoff can have low friction as well as good distribution, as at a fan inlet.

12) In transformations and changes of direction, it is the separation angle that causes a loss.

13) Supply tees should have splitters in them. Exhaust tees should not. There should be volume dampers upstream from an exhaust tee.

14) Care to keep loss down should run on a line from the fan through all fittings through to the farthest outlet. In practice the short runs will be choked off by dampers to reduce the flows to the design values.

15) Design on a velocity basis—not attempting equal pressure loss. A short table may be prepared in advance giving several steps in velocity and in sq in. per cfm.

16) If the rules learned from actual test data are followed, ducts of any proportion or size may be used.

[This is the seventh and last of a series of articles by Mr. Walker on this subject. Earlier ones appeared in the March, May, July, September, and November 1949 and March 1950 issues. In April 1949, some corrections and amplifications were published.]

**SYMBOLS**

$AW$ = (aspect width) = (duct dimension normal to plane of bend) / (duct dimension in plane of bend)

$CR$ = (curve ratio) = (inside radius) / (outside radius)

$D$ = (equivalent diameter) = (feet) = ¼ (sectional area, square inches) / (perimeter, inches)

$d/D$ = (diameter ratio) = (orifice diameter) / (pipe diameter)

$f$ = (friction coefficient, straight pipe) = $h\,D/L\,q$; plotted vs. $R.N.$

$f'$ = (friction coefficient, shock losses) = $h/q$

$h$ = (loss of total pressure) = (inches 32 F water column)

$h = q\,f'$; shock losses, obstructions

$L$ = (length of duct) = (feet)

$q$ = (one velocity head of the average velocity) = (inches, 32 W water column)

$R.N.$ = Reynolds number

## STUDIES THREE DIMENSION STRESS ANALYSIS

A $4000 RESEARCH grant has been awarded Dr. Max M. Frocht, research professor of mechanics at Illinois Institute of Technology, by the Research Corp. for fundamental study in three dimensional photoelastic stress analysis.

Until recently photoelasticity has been confined mainly to two dimensions, with the stress in depth assumed to be constant. In three dimensional work, studies have been limited to symmetrical objects.

Dr. Frocht's work will be to extend the scope of photoelasticity to general problems and to improve the method for symmetrical problems. It will include a study of fundamental principles, perfecting methods and techniques, and an application to practical problems.

Photoelasticity is an experimental method of determining stress by applying loads to transparent models of real objects in a polariscope and analysing quantitatively the pattern produced by the interaction of the polarized light with the model.

The study today rests, in the main, on the ability to permanently freeze or fix a pattern into a material after the loads have been removed.

# *ASTM Committees Discuss Specifications*

DURING ASTM committee week in Pittsburgh earlier this year, much new research work was discussed at the some 300 meetings of the American Society for Testing Materials technical committees, and many new specifications and tests for materials and numerous revisions were completed.

Most of the new and revised standards completed at the meeting are subject to letter ballot in the committees before they are referred to the parent society for action. In general the new specifications will be considered finally at the ASTM annual meeting in Atlantic City during the week of June 26.

Editorial revisions in specification A 53 for welded and seamless steel pipe were approved by subcommittee IX of committee A-1 on steel, including a proposal to clarify the marking for bessemer pipe. Also in specification A 83, which includes lap welded iron boiler tubes, it is proposed to clarify the chemical composition on the alternate type B open hearth iron by stating that it may be produced with a copper content of 0.20 maximum or with a molybdenum content of 0.05 to 0.15 and copper 0.40 minimum.

In 1949 specifications A 157-44 for alloy steel castings for valves, flanges and fittings for high temperature service, and A 217 for alloy steel castings suitable for fusion welding for high temperature service were consolidated into a new specification, A 217-49 T, covering ferritic grades. Since several austenitic grades were included in A 157-44 there is a need for a new specification covering these new grades and a group has been appointed to draft such a document.

In 1949 a tentative revision of specifications A 234 for factory made wrought welding fittings was published which included the 1 percent chromium, $\frac{1}{2}$ percent molybdenum grade of material. It is proposed to include this tentative revision in the body of the specification. It has also been brought to the attention of committee A-1 that there is a need in industry for a specification for stainless steel welding fittings to be used in conjunction with the stainless steel pipe covered by sectional committee B 36. The drafting of specifications covering this product is under way.

In specification A 193 for alloy steel bolting material for high temperature service, it is proposed to delete grades B 4, B 11, B 12, B 13, and B 15, in view of the fact that the tonnage of steel produced to these grades seems to be very small or nonexistent. Also, in specification A 320 for low temperature bolting materials, the section on nuts and washers will be revised to clarify further the grades of nuts which should be used with the various alloy bolting steels covered by the specification.

A new specification is under way for fusion welded alloy steel pipe for high temperature service. There is demand for this type of pipe in central power station installation for reheat and main steam lines of large sizes and heavy walls to eliminate the need for forged and bored pipe. Several alloy grades of compositions now prevalent in high temperature use would be included, such as $\frac{1}{2}$ percent chromium; $\frac{1}{2}$ percent molybdenum, 1 percent chromium; $\frac{1}{2}$ percent molybdenum, $2\frac{1}{2}$ percent chromium; and 1 percent molybdenum.

Committee A-10, on iron-chromium-nickel and related alloys agreed to act upon a request for specifications for centrifugally cast alloy iron pipe and to seek the cooperation of committee A-1 on steel in this matter as has been done in the consideration of specifications for seamless tubing.

In the field of pipe and tube, requirements for automotive and refrigeration tube are being developed by committee B-5 on copper and copper alloys, and Rockwell hardness requirements are being reviewed in all the pipe and tube specifications. In specifications B 135 for seamless brass tubes, consideration is being given to the addition of requirements for 90-10 copper-zinc alloy. The dimensional tolerances in specifications B 111 for seamless condenser tubes are undergoing thorough study.

Specific recommendations for pipe and tube products include the revision of the present iron limit of 1.0 percent maximum in specifications B 111 to a range of 0.5 to 2.0 percent; also a revision of specifications B 88 for seamless copper water tube in accordance with simplified practice recommendation R 217-49 for copper water tube and copper and brass pipe issued by the U. S. Department of Commerce.

Two alternate proposed methods for measuring thermal conductivity of pipe coverings were discussed by committee C-16 on thermal insulating materials, and it is expected to have a proposed tentative ready at the time of the fall meeting. In the field of special thermal properties, proposed methods of test for specific heat and emissivity are being prepared with progress slow in setting the temperature limits on high temperature block. A very comprehensive survey has been completed on the establishment of tolerances in pipe coverings in which some 40,000 readings have been taken. Tables and graphs have been prepared and action was approved to submit this information as a proposed recommended practice for dimensional standards for pipe coverings.

The editorial subcommittee of committee D-19 on industrial water reported that final drafts of chapters for the manual on industrial waters are expected to be completed prior to the annual meeting and it is planned to present the manual to the society for publication by the end of the year. Under methods of sampling, a recommendation was accepted for the continuation without revision of the method of sampling boiler water from stationary boilers (D 860 T). Four new methods of analysis were presented for adoption as tentative, covering sodium and potassium, electrical conductivity, hardness (soap titration), and a method of identification of micro-organisms. Recommendations were approved accepting the revision which has been prepared covering the method of test for silica in industrial waters (D 859 T) and revision of the recommended practice for application of X-ray diffraction methods to water formed deposits (D 934 T).

## YOU COULD DRIVE A TRUCK THROUGH THIS PIPE LINE

YOU COULD drive a two ton truck through the new wood pipe line installed at the Toketee hydroelectric plant for California Oregon Power Co. on the Umpqua river, between Medford and Yamsey, Oregon. This project was designed to divert water from the Umpqua river for the development of vital hydroelectric power.

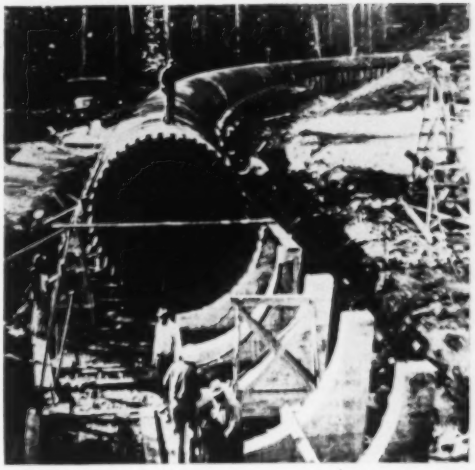
The installation consists of 1663 ft of continuous stave wood pipe with an inside diameter of 12 ft. Approximately 300,000 board feet of lumber was required to complete the job.

All but 700 ft of this installation was built on curves. To withstand high pressures, 272,000 lb of steel bands were used to encircle and hold wood staves securely. Each pipe band is in two sections, connected and held firm with malleable iron pipe shoes.

The staves were constructed of 4 in. by 6 in. redwood, milled to a circle inside and outside with true radial lines. Each stave has a special tongue and groove detail.

Much of the pipe was constructed on a double curve with a 600 ft radius. The pipe line is supported by concrete cradles at 8 ft centers on the curved portion of the line, and 10 ft centers on the straight section. The curves in this pipe line were accomplished by building short portions of the line on a tangent, and then bending the line into position before placing all the hoops and before cinching them thoroughly.

Construction of the line began at opposite ends and proceeded toward the center where both segments were joined. Weather conditions at the installation site made it necessary to complete the project before heavy rains and snow set in. As a result, day and night crews were maintained a good portion of the time in order to meet this deadline.



**Approximately 300,000 board feet of redwood lumber was required to build this 1700 ft wood pipe line for a hydroelectric project in Oregon**

The pipe line takes the water from a concrete conduit under the dam and diverts the water into a tunnel some 1600 ft downstream.

The designs and specifications for this huge wood pipe line were prepared by the Pioneer Service and Engineering Co., Chicago, for the California Oregon Power Co. The wood stave pipe was prefabricated by the Santa Fe Tank & Tower Co., Los Angeles, who also supervised the installation.

## SHOOTING TROUBLE IN REFRIGERATION SYSTEM

IN THE ARTICLE on Shooting Trouble in a Refrigeration System, published in the April HPAC, the author has detailed the steps taken in correcting the faulty operation of the plant in an interesting and amusing manner. He observed the symptoms and, with some straight thinking, he diagnosed the trouble.

He points out the very obvious fact that an ice builder can only produce ice when the refrigerant temperature is below 32 deg.

Ordinarily, a suction pressure regulator is not needed on an ice builder. If the refrigerant compressor is also operating on other loads, particularly if it is operating on low temperature loads, such as ice cream hardening rooms, it may be necessary to use the suction pressure regulator in connection with the ice builder. For example, if in order properly to refrigerate the rooms, a refrigerant temperature of —10 F is needed and the ice builder alone would load up the compressor to a suction pressure equivalent to +15 F, it would then be logical to install a pressure regulator on the ice builder to maintain a downstream pressure equivalent to the —10 F required for the storage room.

The ice builder would then use the excess capacity of the compressor over and above what was needed to properly refrigerate the room. It would, of course, be much more efficient from a power consumption standpoint to have the proper size compressor for the storage room for operation at —10 F refrigerant, and the proper size machine to operate on the ice builder to work at, say, +15 F refrigerant. On the other hand, it is sometimes desirable where a compressor is operating on a number of rooms, some of which may shut off automatically, to have some additional load which can be put on this machine to keep it from pumping down to lower pressure when the primary load falls off.

Incidentally, ice builders can be employed to great advantage on many dairy applications. They then allow the use of a small refrigerating plant, reduce the electric demand charge, enable high peak loads to be carried, provide a reserve of refrigeration in case of short failure of the refrigerating plant and simplify control problems. The difficulties described in the April issue article were matters of faulty operation and control rather than inherent defects in the ice builder itself.—LEON BUEHLER, JR., chief refrigeration engineer, The Creamery Package Mfg. Co.

# Piping's a Major Part of Soy Oil Extraction Plant

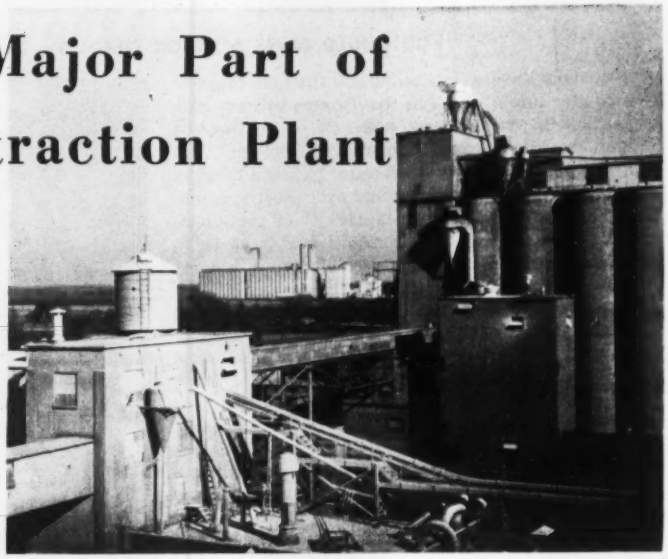


*Fig. 1—Two of the three major exhibits supporting Decatur's claim to the title of Soy Bean Capital of the World.*

*EXTENSIVE PIPING systems carry cold water, recirculated water, steam, condensate, soy oils, solvents and refrigeration in the soy bean industry. In words and pictures, George Holman describes some of the piping and other equipment features of the new Spencer Kellogg & Sons solvent process soy oil extraction plant at Decatur, Ill.*

IN THE SOY BEAN processing industry, piping is used for various fluids at various temperatures, pressures, viscosities and rates of flow. Extensive systems carry cold water, recirculated water, steam, condensate and soy oils. In the solvent process of soy oil extraction, complete circuit piping systems also must be installed to carry the solvent, hexane, and a refrigerant, usually ammonia.

The principle of soy oil extraction by the solvent process is a simple one. Crushed beans are fed into a "solvent tank" where, under moderate temperature, the oil is dissolved in hexane. The oil and hexane mixture is then drawn off, and the hexane driven out of the oil by heating. This hexane is condensed for reuse by passing through an ammonia evaporator. In practice, however, an extremely complicated system is required, with numerous other vessels, machines, instruments and pipe lines. The vessels may be of the pressure type or the storage type.

In the construction of Spencer Kellogg & Sons' new soy oil extraction plant at Decatur, Ill., the two solvent tanks and other large vessels were installed at the time the building skeleton was erected. Smaller vessels and the connecting pipe lines were installed later. This included the entire refrigeration system, with two 8 in. by 8 in. ammonia compressors, one horizontal shell and tube condenser, a liquid receiver and four vertical shell and tube evaporators.

The presence of soy bean dust in the atmosphere of a soy oil extraction plant, the inflammable oily product in both liquid and finely divided form suspended in the air, and the use of hexane make such a plant subject to explosion hazards.

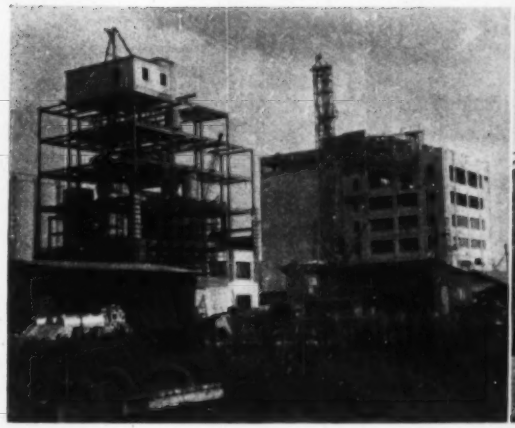
Because of the explosive atmosphere frequently surrounding the refrigeration system, and the tendency of the flowing refrigerant to generate a static electric charge on any ungrounded section of pipe, all refrigerant piping was thoroughly grounded, either by welding of sections or by installing copper conductors across the screwed or flanged joints.

Some of the methods used in the construction of piping systems at this plant are illustrated in the accompanying pictures.

Fig. 1 shows two of the three major exhibits supporting the claim of Decatur to the title of Soy Bean Capital of the World. The Archer-Daniels-Midland "bean mill" is in the distance, as seen from the sixth floor of Spencer Kellogg's new solvent process soy oil extraction plant. Bean "tanks" and part of the old expeller process plant are in the foreground.

The steel framework of Spencer Kellogg's new solvent process soy oil extraction plant as it appeared July 30, 1949, is shown in Fig. 2. Stories are a minimum of 15 ft. The two solvent tanks rise into the fourth story, as seen at the left part of the building.

Fig. 3 shows the soy oil receiving vessels, with the induced draft cooling tower of redwood in the left background and the extraction plant at the right. These vessels have three compartments each, thereby permitting sludge to be cleaned from one compartment while the oil is held in the other two. When an ammonia expansion valve of a shell and tube evaporator on the sixth floor became clogged with scale during the first month of operation, excessive



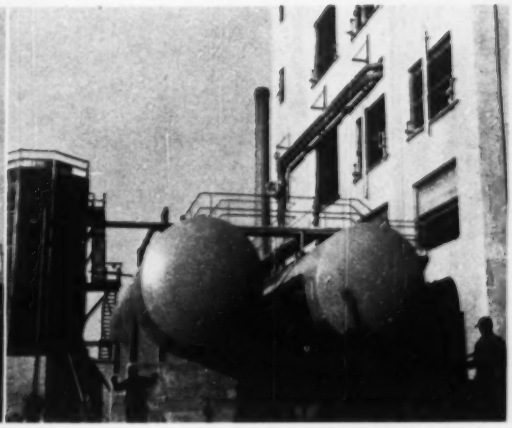


**Fig. 2** *(left)*—**The two solvent tanks for the new extraction plant rise into the fourth story of the building. Fig. 3** *(right)*—**These soy oil receiving vessels have three compartments, permitting sludge to be cleaned from one while the oil is held in the other two**

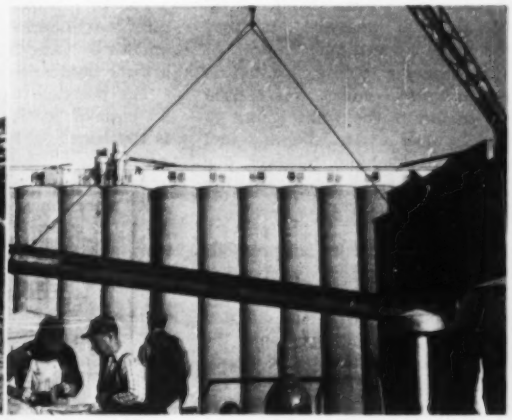
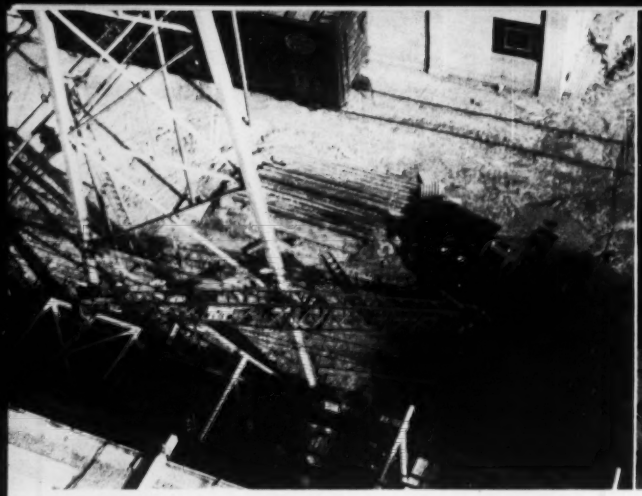


**Fig. 4** *(left)*—**Mechanical ditching was used for much of the underground piping. Fig. 5** *(right)*—**Cranes with 100 ft booms facilitated installation of overhead piping. Wooden block at left of pipe bundle prevents choker from slipping**

**Fig. 6** *(left)*—**These pre-insulated sections of oil pipe lines have two and three pipes per bundle. Fig. 7** *(right)*—**The tall, nearly square building is the new oil pumping station and the tanks are for oil storage**



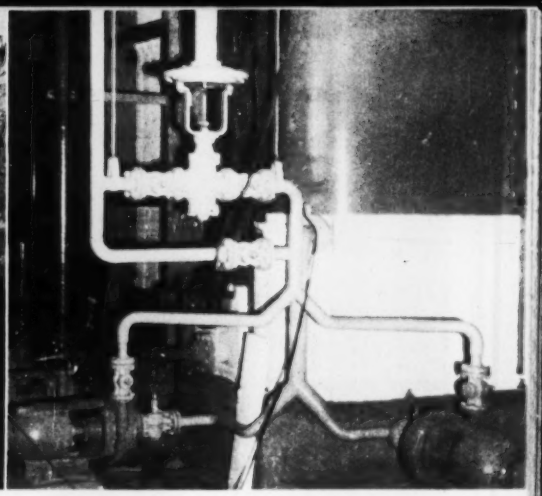


**Fig. 8** *(left)*—**Crane lifting pipe section into hangers before welding. Fig. 9** *(right)*—**Welding proved especially valuable in fabricating the piping to parallel these two pumps**

amounts of hexane carried over into these oil receivers, and they had to be cleaned out.

Ditching for piping installation by mechanical means was carried out as far as the point shown in Fig. 4. Most of the ditching had to be done by hand, however, due to the presence of numerous other underground conduits and pipe lines.

Cranes with 100 ft booms facilitated the lifting of heavy pipe sections, as shown in Fig. 5. The wooden block seen at the left end of the pipe bundle prevents the choker from slipping. The mushroom-shaped ventilators at the right of the photo are on the third story roof section.

The pre-insulated sections of oil pipe lines shown in Fig. 6 have two and three pipes per bundle. These are for outdoor service.

The practical aspect of erecting an outdoor pre-insulated pipe line is illustrated in Fig. 7. Bundles of pre-insulated pipe sections are laid out on the ground prior to lifting into place on pipe-pole supports based in concrete blocks. Oil storage tanks are in the background. The tall, nearly square building in the left background is the new oil pumping station.

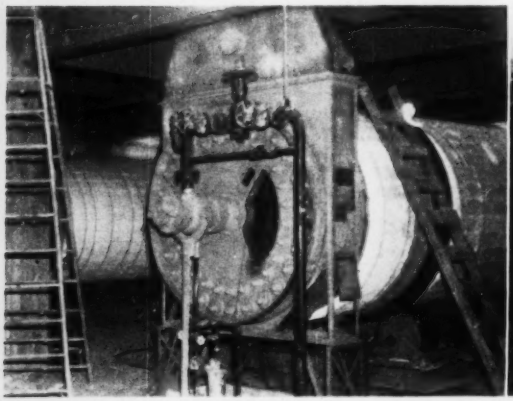
Despite numerous obstacles, cranes proved their value in lifting pipe sections into their hangers before welding, Fig. 8. Hangers are hung from cross-arms made by welding a short section of pipe across the top of the pole of the same size pipe.

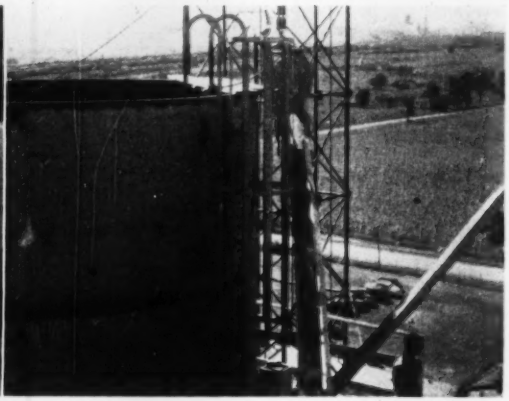
All pipe and tank supports were fabricated by welding. Welding proved of especial value in fabricating the pipe for paralleling the two pumps seen in Fig. 9. One of the two solvent processing tanks at the right is being insulated with 85 percent magnesia.

Fig. 10 shows the steam piping for a "roaster-toaster," which is being insulated with block magnesia.

A tank on the 6th story roof for storage of recirculated water cooled by passage through the cooling tower shown in Fig. 3 is illustrated in Fig. 11.

**Fig. 10** *(left)*—**Steam piping for a "roaster-toaster". Fig. 11** *(right)*—**This tank on the sixth story roof stores recirculated water cooled by a cooling tower**





# *Codes and Specifications for*

# WELDED PIPING

DESIGN AND construction of welded piping systems for industrial installations should comply with existing codes and specifications, all of which are written on the basis of minimum requirements for safety. Certain applications, however, may require more conservative design and construction precautions than stipulated in these codes. For instance, a particular application may necessitate extra allowance for corrosion or erosion, lower stresses than specified due to a requirement of minimum distortion or creep, X-ray or gamma-ray inspection of all joints where the penalty for a leak is extraordinary.

The American Standards Association Code for Pressure Piping (B31.1) deals particularly with minimum safety requirements for the selection and designation of dimensional standards, materials, design, fabrication, erection and testing of piping systems. The principal purpose of the code is to serve as a guide to state and municipal authorities in drawing up their regulations; also to serve architects, engineers, equipment manufacturers and erectors as a standard of reference with respect to pressure piping. The code is composed of seven sections: power piping, gas and air piping, oil piping, district heating piping, refrigeration piping, fabricating details and material identification.

The American Society of Mechanical Engineers Boiler Construction Code, which also covers piping connected with boilers, is the only code which has been legally recognized and made mandatory by state and municipal authorities. Where so recognized, compliance is prerequisite to acceptance of the installation by the states and insurance companies. There are nine sections in the code, of which the following have references to industrial piping:

(a) Section I, Power Boilers, formulates minimum specifications for the construction of piping directly connected to steam power boilers within prescribed limits. Where specific rules are not given in other sections, the rules in Section I may be used.

(b) Section VIII, Unfired Pressure Vessels, contains rules and computation methods for the attachment of piping to vessels.

There has also been prepared by joint sponsorship of the American Petroleum Institute and the American Society of Mechanical Engineers, the API-ASME Code for the Design, Construction, Inspection and Repair of Unfired Pressure Vessels for Petroleum Liquids and Gases, which includes connecting piping. This code permits more liberal design factors than Section VIII of the Boiler Code consistent with oil refinery practice, but as a safeguard this code includes a mandatory inspection and repair schedule.

### Procedure and Welder Qualification

It is now a generally accepted fact that in order to obtain a satisfactory welded piping installation it is necessary to first establish and qualify a definite welding procedure and, second, qualify the necessary welders to carry out that procedure. The procedure should cover base metal specifications, preparation of welding ends, filler metal, welding technique, preheat and postheat temperature.

A satisfactory procedure having been established, the quality of welding will then depend on the ability of the welder working under proper supervision. Codes for qualification of procedure and operators are as follows:

The American Welding Society Standard Qualification Procedure, published as a separate pamphlet, is also contained in chapter 60 of the AWS Welding Handbook. Part I relates to the method of qualifying a contemplated welding procedure and Part II to the method of qualifying welders under a satisfactory given procedure. The rules apply to both manual arc and gas welding processes.

The ASME Boiler Construction Code, Section IX, contains the same subject matter for application to piping as the AWS Standard Qualification Procedure, except that reference is made to ASME (ASTM) Material Specifications.

The American Standard Code for Pressure Piping (B31.1) contains in Appendix I a form of the AWS Standard Qualification Procedure, modified with special reference to piping.

The Heating, Piping and Air Conditioning Contractors National Association has formulated standard welding procedures for manual metal arc and oxyacetylene welding of pipe. The National Certified Pipe Welding Bureau is an affiliate of this association, having as its purpose the administration of welder qualification tests in a uniform manner in accordance with the association's standard procedures,

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Taken from the Welding Handbook, third edition, published by the American Welding Society. The chapter on industrial piping of this handbook was prepared by a committee consisting of D. H. Corey, The Detroit Edison Co., chairman; A. N. Kugler, Air Reduction Sales Co.; J. D. Mattimore, Tube Turns, Inc.; J. Hall Taylor, Taylor Forge & Pipe Works; H. Weisberg, Public Service Electric and Gas Co.; and C. C. Zimmerman, Benjamin F. Shaw Co.

and the interchange of qualified welders between contractors who have adopted the standard procedures, without the necessity of retesting them.

When procedures and welders have been qualified under Section IX of the ASME Boiler Construction Code, such interchange of qualified welders, between employers following identical welding procedures, is acceptable for piping work within the scope of that code.

The National Board of Boiler and Pressure Vessel Inspectors was organized to administer uniformly the rules of the ASME Boiler Code. It is composed of chief inspectors of states and municipalities which have adopted the Boiler Code. A pamphlet issued by the National Board entitled Recommended Rules for Repairs by Fusion Welding to Power Boilers and Unfired Pressure Vessels (over 15 lb pressure) makes reference to seal welding and repairs to boiler tubes and pipe of low carbon steels of known weldable quality and having a carbon content of less than 0.35 percent. For welding alloy steel, reference is made to the ASME code. Appendices are included relating to welder qualification tests. No repairs by welding may be made without an inspector's approval.

### High Alloy and Nonferrous Materials

All of the above codes deal almost exclusively with piping of carbon and low alloy steel. While the ASME Boiler Construction Code and the ASA Code for Pressure Piping publish allowable working stresses which may be utilized for determining the minimum permissible thickness of some high alloy and copper, nickel and aluminum pipe, the designer, in general, must depend on the principles set forth in these codes governing welded steel piping systems for guidance. In the case of procedure and welder qualifications, it is strongly recommended that the same *type* of qualification procedure be followed for high alloy and nonferrous piping as that which is mandatory for materials specifically covered by the codes.

### Ferrous Materials and Dimensional Standards

Dimensional standards, covering carbon steel pipe, cast and forged valves, fittings and flanges, were originally developed on the basis that they would be assembled into piping systems by means of mechanical joints. During the past 20 years many of these standards have been modified to take cognizance of the use of welding. Entirely new dimensional standards have been developed for butt welding and socket welding fittings. These standards provide pressure-resisting fittings equal in strength to seamless pipe with considerable decrease in weight and space requirements over flanged fittings. Complete lines of such fittings, made from seamless pipe, solid forgings or plate, have been developed.

Simultaneous with the development of such dimensional standards by the American Standards Association, ASTM Standards governing the material requirements for pipe, tubing, castings, forgings and flanges for piping were either modified to provide for their use in welded systems or newly created specifically for such use. Both the American Society for Testing Materials and the American Standards Association are currently engaged in formulating new standards covering alloy steel piping components, under a program started in 1930 and somewhat retarded by World War II. The concurrent standardization of electrodes and welding rods for the most part has been carried out without specific reference to their use in welding pipe, but has been helpful.

### Nonferrous Materials and Dimensional Standards

Under the heading of nonferrous materials, the metals used in welded piping systems may be grouped as follows:

1) Copper and copper alloys (includes red brass, yellow brass, silicon bronze and copper-nickel).

2) Nickel and nickel alloys.

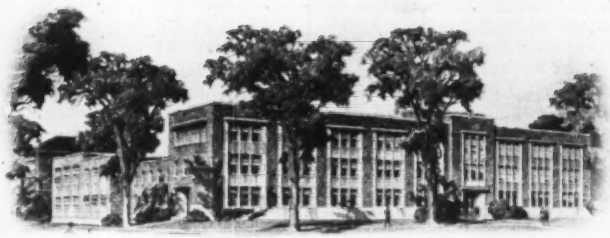
3) Aluminum and aluminum alloys.

4) Lead.

While there are a number of ASTM standards covering pipe or tubing for the first three groups, these standards have been created without specific reference to the means used in assembling them into piping systems. ASTM Standard Specifications for Copper Pipe, Standard Sizes (B42) and Standard Specifications for Red Brass Pipe, Standard Sizes (B43), contain dimensional tables for regular and extra strong pipe which correspond to standard weight and extra strong iron pipe size and dimensions. ASTM standards also exist for some alloy castings and, in the case of copper alloys, standards specifically intended for use in manufacturing valves and fittings. These standards likewise contemplate the use of mechanical rather than welded joints.

There are no American Standards regulating the dimensions of nonferrous pipe, valves, fittings and flanges other than those for screwed brass fittings and for brass soldered joint fittings. Since the nickel and aluminum groups are used mainly for corrosion resistance, avoidance of fluid contamination or sanitary reasons, usually under mild conditions of pressure and temperature, the practice has been to construct valves, fittings and flanges to the dimensional standards used by manufacturers of comparable brass components.

Valves of the copper and nickel groups are frequently soldered or brazed into piping systems but are seldom welded. On the other hand, extensive use of welding fittings of all four metal groups is common. In the case of all but lead, such nonferrous welding fittings are often made to the same dimensions as iron pipe size wrought carbon steel butt welding fittings (ASA B16.9). Because of the greater cost of these metals and the relatively mild pressure-temperature service conditions to which they are generally applied, such fittings and the pipe to which they are welded are more commonly made with considerably less wall thickness than their carbon steel counterparts. In other instances, and for the same reasons, tubing having different outside diameters than pipe but with even thinner walls than lightweight pipe and matching fittings are employed. These types of construction generally involve the use of transition pieces or adapters to permit connection to screwed and sometimes to brazed valves and other apparatus.



# U. of I. Dedicates New M. E. Building

*J. R. FELLOWS, professor of mechanical engineering at the University of Illinois, briefly describes the heating and ventilation for the new mechanical engineering building at Urbana. Copper convectors supplied with exhaust steam from the university power plant serve the offices and classrooms, the machine tool laboratory is heated by seven unit heaters, and laboratories requiring special ventilation treatment are heated by raising the temperature of the supply air to the level required to balance the room heat losses*

DEDICATION ceremonies are being held in Urbana this month for the new mechanical engineering building at the University of Illinois. It is a modern three story brick structure containing 87,630 sq ft of floor area, and includes 16 classrooms, three lecture rooms, 10 design rooms, 15 laboratories, two computation rooms, and three seminar rooms for instruction and research purposes. There are 45 private and semi-private offices for the staff, and an attractive suite is occupied by the head of the department and his secretaries. A room adjacent to the departmental office is used for staff conferences.

An attractive lounge near the building's south entrance is provided for the use of students, there is a workshop equipped for the construction of special equipment, and a model room for displaying items of interest to students and visitors. Two large locker rooms and seven toilets are included in the interior arrangement. The mechanical and electrical equipment which serves the building is housed in five basement rooms and in a penthouse.

## Convectors Heat Classrooms, Offices

Exhaust steam at approximately 8 psi gage pressure from the back pressure turbines in the university's Abbott power plant—approximately $1\frac{1}{4}$ miles distant—is transported through pipes in underground tunnels and used in all of the building's heat disseminators.

Classrooms and offices are heated by copper convectors under the windows. The steam flow to the convectors in each room is regulated by valves at the inlets which are operated with compressed air under the control of the room thermostat. The thermostat is designed to increase gradually the air pressure in the bellows which operate the valves when the room temperature rises above its setting. Increased air pressure in the bellows moves the valves toward a closed position and reduces the flow of steam. When the room temperature falls below the thermostat setting, the air pressure in the bellows is gradually reduced and the flow of steam is increased. Air and condensate from each unit pass through a thermostatic trap into a return line in which a suitable reduced pressure is maintained by a vacuum pump of the centrifugal type.

The 60 ft by 120 ft machine tool laboratory contains approximately 130 machines of various types for metal cutting. It is heated by seven unit heaters mounted near the ceiling and arranged to direct the heated air toward the floor. The internal combustion engine laboratory, the welding laboratory, and certain others which also require special treatment in regard to ventilation, are heated by raising the temperature of the supply air to whatever level is required to balance the heat losses from the rooms.

## Eighteen Fans Provide Ventilation

Eighteen fans are used for moving air to and from the various rooms for which mechanical ventilation has been provided. The largest one of these, installed in the penthouse, is capable of delivering 47,000 cfm of tempered, filtered, humidified and reheated air to offices and classrooms on the second and third floors of the main section of the building. A second fan, also in the penthouse, is capable of removing 23,500 cfm from the same rooms.

The duct shown in the foreground of the accompanying photo of the penthouse fan room carries air which is exhausted from offices and classrooms on the first floor and in the basement. The fan which handles this air is in a room in the basement and the long vertical portion of the duct between the fan

room and the part shown is placed in a space provided adjacent to the elevator shaft. The fan which supplies treated air to the same rooms is located beside the exhaust fan. A separate outdoor air intake serves this system. A tempering coil for this system is located in the penthouse. A long vertical duct carries this air to the basement fan room where it is mixed with recirculated air, filtered, humidified and reheated preparatory to its delivery to the rooms served.

The motor generator set shown in the right foreground of the fan room photo furnishes direct current for the operation of the automatic elevator which serves all four floors.

The automatic control mechanism used with each of the two ventilating systems which have been mentioned consists of several parts which act cooperatively to produce the desired results in the most economical manner. A ductstat, located after the tempering coil, maintains the temperature of the mixture of outdoor air and recirculated air at 44 F during cold weather through the combined action of a steam valve and a bypass damper. A room humidistat controls the rate of evaporation in a pan type humidifier located between the filter, which is downstream from the tempering coil, and the reheat coil. A room thermostat, near the center of the area served, controls the temperature of the air leaving the fan by the combined action of a valve in the steam pipe which serves the reheat coil and a face and bypass damper immediately upstream from this unit. A low limit ductstat controls the reheating of the air when the room thermostat is satisfied.

The minimum outdoor air damper, which opens wide when the fan is put into operation at high speed, guarantees that at least 50 percent of the supply air is taken from outside. The proportion of outdoor air is gradually increased from 50 percent when its temperature rises above 40 F. This is accomplished by the coordinated action of a maximum outdoor air damper in the outdoor air intake, a damper in a duct connecting the exhaust fan discharge with the mixing chamber, and a damper in a duct carrying exhaust air to the outdoors. All three of these dampers are under the control of a thermostat placed in the outside air and their combined action serves to increase gradually the intake of outdoor air and decrease the amount of air that is recirculated, until 100 percent outdoor air is used when its temperature is such that no heating is required.

### Special Ventilation for Laboratories

A special ventilation system adapted to the peculiar needs of the room is provided for each of the laboratories where noxious gases are released by the processes which are carried out in it. An example is the heat treatment of metals laboratory, the dimensions of which are 26 ft by 54 ft by 18 ft, giving an interior volume of 25,000 cu ft. When on day operation, the supply fan serving this room delivers 8000 cfm of heated and humidified air and an exhaust fan removes approximately the same volume, giving a complete air change in the room in approximately 3 min. All of the supply air is taken from outside, and it is delivered horizontally through 15 outlets in the sides of a supply air trunk suspended from the ceiling, approximately 10 ft above the floor. Air is exhausted from this room through 10 hoods suspended over the individual furnaces and through three exhaust grilles in the side of the exhaust trunk located close to the ceiling in the end of the room where the greater part of the heat treating work is done. When on night operation, the exhaust fan is inoperative, the damper in the outdoor air intake is closed, a recirculation air damper is opened, and the room thermostat, which indirectly controls the valve in the steam pipe serving the heating coil, is set to maintain the temperature in the laboratory at 60 deg. There is no provision for heating the special laboratories except through the ventilation systems.

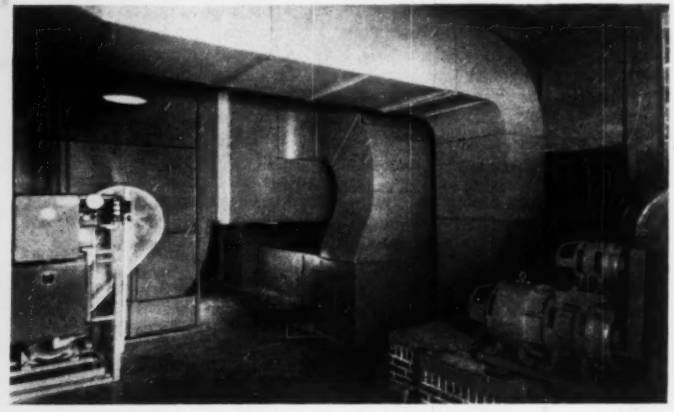
### Mechanical Ventilation for Offices

Mechanical ventilation is provided in only those private offices on the south side of the main wing of the building, in order that some relief from summer heat may be obtained by the circulation of night air. All of the other offices depend on double hung windows for ventilation.

No ventilation air is supplied to the toilets, but approximately 3300 cfm is removed from them through three special toilet exhaust systems. The toilets are heated by convectors of the same type that is used in offices and classrooms.

Due to a limited appropriation and the desire to provide the maximum amount of badly needed space for classrooms, laboratories and offices, no equipment for cooling and dehumidifying the ventilation air during hot weather has been provided.

**Side view of 47,000 cfm supply fan in the penthouse; a 23,500 cfm exhaust fan is directly back of the elbow in one branch of the supply duct. The duct in the foreground carries air exhausted from offices and classrooms on the first floor and in the basement**



# PRACTICAL PIPING PROBLEMS

By Robert C. Soronen

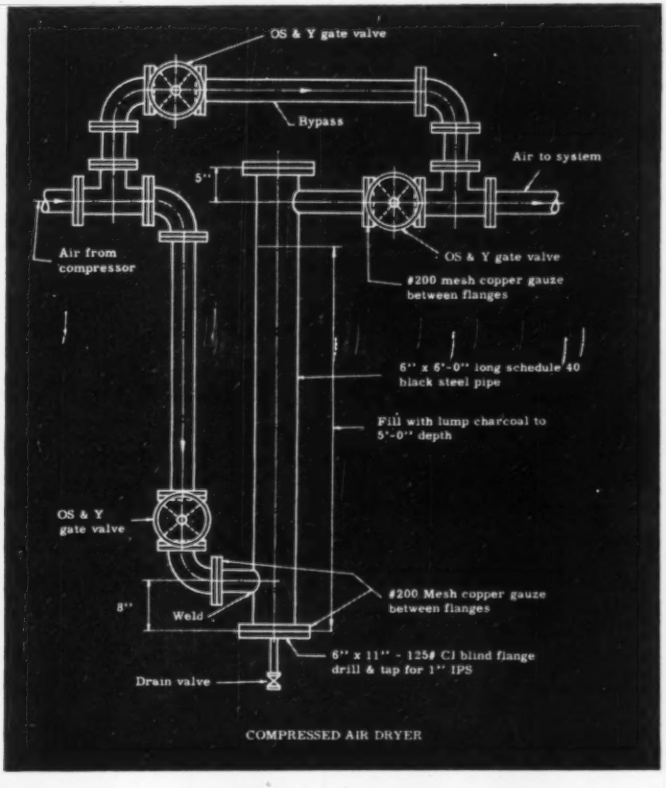
ROBERT C. SORONEN, engineer specializing in the design and supervision of heating, ventilating, air conditioning, industrial exhaust systems, process piping, and drying installations, describes a method of removing moisture from compressed air lines which he has used.

## COMPRESSED AIR DRYER IMPROVES OPERATION

ENTRAINED moisture or vapor in air lines is condensed to water after compression. Unless this water is trapped or removed immediately, it finds its way to the air operated equipment.

Water in air operated equipment disperses lubricating mediums, resulting in mechanical difficulties because of undue wear on machined surfaces through lack of the proper lubrication. Thus, increased operating efficiency can be obtained by the provision of a compressed air dryer.

In conjunction with small compressed air units where the initial investment and operating costs may not make it advisable to install an aftercooler, the installation of dryers in the piping main or branches will effectively increase overall efficiency and decrease maintenance.


OS & Y gate valve
Bypass
Air to system
5"
Air from compressor
OS & Y gate valve
#200 mesh copper gauze between flanges
6" x 6'-0" long schedule 40 black steel pipe
Fill with lump charcoal to 5'-0" depth
OS & Y gate valve
8"
Weld
#200 Mesh copper gauze between flanges
6" x 11" - 125# CI blind flange drill & tap for 1" IPS
Drain valve

COMPRESSED AIR DRYER

Illustrated here is an effective compressed air dryer which I have used on a number of installations. It is constructed from standard weight pipe and fittings, 200 mesh copper gauze for insertion between flanges where indicated, and machine bolts or studs. A small amount of lump charcoal, simply removed and recharged, acts as the absorbent agent.

## WATER RE-USE IS ANSWER TO SHORTAGE

REFERRING TO the article entitled Water, Water Everywhere. . . . But Not Enough, in the February issue, not enough consideration has been given to conservation of our natural resources.

Conservation is the real answer to the water shortage problem, plus large scale re-use of waste water.

A recent article in Water and Sewage Works tells of use by an oil refinery of the effluent water from the sewage treatment plant of the city of Big Springs, Texas. A half million gallons of water per day is reclaimed and used for boiler feedwater and other purposes by the Cosden Petroleum Co. refinery. The net result of this deal was that the oil company gets this water for 7¢ per 1000 gal, thus making a saving of 4¢ over the cost for city water.

There are thousands of industrial plants using water in cooling processes, in cooling engine and air compressor jackets and for washing air in paint spray booths and other dust eliminating equipment. No direct discharge of such water to sewers should be permitted. Cooling water should be reclaimed by cooling towers; wash water should have the sediment removed and the water should be re-used. Cooling towers should be a must in all air conditioning installations.

Industrial waste waters should be chemically treated and re-used as far as possible. In fact, most city and county ordinances require such chemical treatment before granting permits to dump such waste water into the sewers. This is to protect the sewers. Additional treatment would often make the waste water re-usable.

Water has been one of our cheapest necessities in most sections of the country. Perhaps if the price starts to climb conservation will be given more attention.—O. W. OTT, consulting mechanical engineer.

# Sam Lewis' Page

INFORMAL COMMENT on heating, piping and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, and a member of HPAC's board of consulting and contributing editors. Suggested topics for comment and suitable questions are welcomed by Mr. Lewis from readers of his "Page." They may be addressed to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, for forwarding to him.

## CORRECTING COMBUSTION NOISE AND VIBRATION

WE HAVE A request from a reader about a high school that has a warm air furnace heating system. The furnace room is in the basement directly under the auditorium, with no provision for furnishing adequate air for combustion purposes unless the door from the furnace room is left open. Complaint is made that there is unacceptable vibration of the auditorium floor, believed to be due to pulsations in the air pressure in the furnace room. It is stated that repeated attempts to adjust the gas burners so as to terminate the shuddering have failed.

I remember a very handsome and apparently well designed oil burning steam boiler in a corner of an industrial plant where, when the burner was operating, the vibration was so great as to break the glass in a 100 sq ft steel window sash of the boiler room wall. The boiler room was at the main floor level, had an outside door, a masonry chimney and a short steel breeching. I caused the breeching connection to the chimney to be rebuilt, hoping to alleviate the reverberations, but accomplished nothing. Opening the outside door wide did not end the trouble. Changes in the steam piping, to improve the disposal of possible condensate, failed to show any improvement. Pages of mathematical computations as to air-oil draft-combustion chamber ratios and temperatures and comparisons with duplicate boilers that were well behaved, all failed to prove a solution. The ultimate end of the trouble came by rebuilding—for the third time—the refractory lining of the oil burner chamber, with relatively small changes in its dimensions.

In another case, four high pressure water tube boilers served a very tall office building. Each boiler had a chain grate stoker on natural draft. The boilers all were so temperamental that when the slightest overload beyond the basic rating of 10 sq ft of heating surface per horsepower was requested of any of them, all the drums of the wildest savages would start to beat. If we opened the draft damper to the slightest extent beyond the critical point the fun would commence. The noise and the vibrations were so great that one would expect rupture of tubes or drums and so, for nearly 25 years, these boilers were held down to a rather inefficient output.

**Mr. Lewis answers a question from the audience at a recent engineering meeting**

Eventually something had to be done about it, and elaborate tests with special instruments and some more mathematics were applied. Pursuits of internal water circulation, steam liberation areas, air injection at various points, modifications in front arches, changes in baffles, stoker speed adjustments—all hopefully carried out—failed to result in any thing but a wish by all concerned to climb out of that boiler room at high speed whenever an attempt was made to burn enough coal to make the old tea-kettles really sing. Here was a case of standard boiler construction, plenty of air for combustion, enormous draft, good water and skilled attendance—yet there was trouble.

Eventually the boilers went quietly to work by so simple a procedure as raising the height of the refractory wall across the rear end of the chain grates. Apparently, the radiant heat, reflected forward by this higher wall, must have increased greatly the efficiency of combustion on the grates and also may have reduced the rate of heat absorption into the lower ends of the water tubes, now behind the higher refractory wall.

To our friend who asks about the high school installation, it is advised that if cutting some holes and running some ducts to bring in air from outside fails, then change the gas burners or possibly install some baffles in the combustion chamber.

## HEAT EMISSION FROM WALL COILS

A FRIEND wishes to be advised on the heat transmission to be anticipated for a wall coil having a mean water temperature of 180 deg. and the influence of superimposed pipes in such a coil.

This is an old problem, rapidly approaching obsolesence, since some prominent manufacturers no longer make the oldtime cast iron branch tees that were used in such radiation.

Expansion and contraction of the different parallel pipes in such a wall coil would be cared for by installing branch tees at the ends of the pipes, with right and left elbows in the pipe runs at some intermediate point between the tees, so as to care for expansion.

It is well known that there must be a temperature difference between the lower and the upper pipes in such a radiator, since the coolest air flows around the bottom pipe, picks up heat there, and thus promotes a reduction in temperature difference between the air and the pipe as the air passes by each successive one.

Amateur steamfitters who built rigid wall coils learned that leakage eventually occurred if the unequal expansion of the pipes was not provided for. I had occasion during the war to use a pipe coil along a wall. No branch tees could be found in the market and it was necessary to weld the headers out of pipe. The supply header was placed horizontally above one end of the coils.

Assuming the air temperature at

**Heat emission of pipe coils placed vertically on a wall (pipes horizontal) containing steam at 215 F and surrounded with air at 70 F**

*Btu per linear foot of coil per hour (not linear feet of pipe)*

| Size of pipe | 1 in. | $1\frac{1}{4}$ in. | $1\frac{1}{2}$ in. |
|---|---|---|---|
| Single row | 132 | 162 | 185 |
| Two | 252 | 312 | 348 |
| Four | 440 | 545 | 616 |
| Six | 567 | 702 | 793 |
| Eight | 651 | 796 | 907 |
| Ten | 732 | 907 | 1020 |
| Twelve | 812 | 1005 | 1135 |

the lowest pipe in the coil at 70 deg and the pipe surface at 180 deg, the temperature difference will be 110 degrees. I know of no exact research tests of the transmission between a water-heated pipe and thermally circulated air, but many tests have been made by weighing the condensate from steam in horizontal pipes under similar conditions.

A table on page 522 in the American Society of Heating and Ventilating Engineers 1949 Heating, Ventilating, Air Conditioning Guide discloses the approximate comparison between superimposed steam pipes in thermally circulated air. This table is reproduced here.

Thus, a 1 in. bottom pipe at 145 deg temperature difference transmits 2.64 *Btu per hr per sq ft of surface per degree temperature difference*, and probably would transmit 290 Btu per hr per sq ft in air at 70 deg with water at 180 deg. The eighth pipe up, under the same conditions probably would transmit only 93 Btu per hr per sq ft, and the average for the eight-pipe coil would be about 178 Btu per hr per sq ft of surface.

Computations for $1\frac{1}{2}$ in. pipe similarly conducted suggest that about 5 percent less heat per sq ft of surface will be transmitted than with the smaller piping, *all other considerations being equal*.

Using this table, it is possible to develop interesting mathematical conceptions but, after all, why not recognize obsolesence and employ modern finned radiation rather than the old, plain, inefficient, smooth pipes?

I have designed the hot water heating for a great many classrooms in large school buildings, using finned 2 in. pipe, one layer of this being run along two walls of a corner room. In most cases sufficient radiation can be installed in this way, at a great improvement in appearance and reduction in cost compared with oldtime pipe coils.

## TWO BOILERS WITH DIFFERENT WATER LINES

A FEW MONTHS ago I made some remarks on my "page" about a suggested attempt to make two low pressure steam boilers serve as a team when one of the boilers was of steel and one was of cast iron, with the water level in one boiler $18\frac{5}{8}$ in. higher than that in the other. It is possible, of course, to operate these boilers together if they are each supplied separately with water by a pump, and if, given the pump, some person stands by constantly to readjust the feed valve on each boiler.

We have a letter from a friend expressing sympathy for the man who was advised by me to throw away one or the other of these mis-mated boilers. He sends a sketch suggesting an unvalved and unobstructed pipe connection taken off at the water level of the higher boiler and running down $18\frac{5}{8}$ in. to the water level of the lower boiler. He thinks that some undisclosed mysterious effect will ensue whereby water will cease to seek its own level.

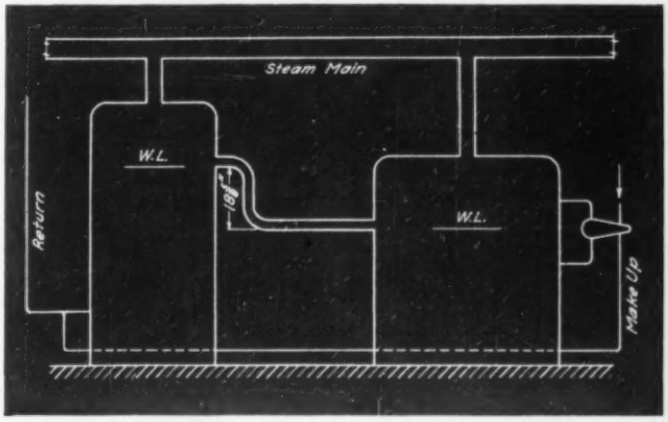
There can be no doubt but that with the piping connected as illustrated in his sketch, the water rising in the lower boiler would be paralleled by water rising in the higher boiler. Thus if enough water enters the lower boiler to reach the desired water line, the water will be $18\frac{5}{8}$ in. below the designed level in the higher boiler, so that the heat-absorbing areas in that boiler will not be protected and so that damage, if not an explosion, could follow.

If the introduction of water continues until the desired line in the higher boiler is reached, the lower boiler will have been converted to a water-heating boiler without any steam space. The open pipe connecting the respective water levels positively cannot solve the problem.

If there is no fire in the lower boiler, no particular harm would follow firing the higher boiler when the water level in it is satisfied; the lower boiler then being merely a storage reservoir for water. The problem, however, was to fire both boilers simultaneously and to make them deliver steam into a header or main common to both, when both receive water from a header or main common to both.

No solution has been found, short of a pump feeding through a water level governor for each boiler, or short of equalizing the water levels by changing the elevation of one of the boilers.

**A friend suggests this way of connecting two boilers with different water lines for simultaneous operation but Mr. Lewis explains why the scheme simply won't work**



DATA *sheet*

# Stress and Deflection in Horizontal Pipe Lines

*By L. E. Partch*

ON THE ACCOMPANYING nomogram for Stress and Deflection of Horizontal Pipe Lines an example is worked out to show its use.

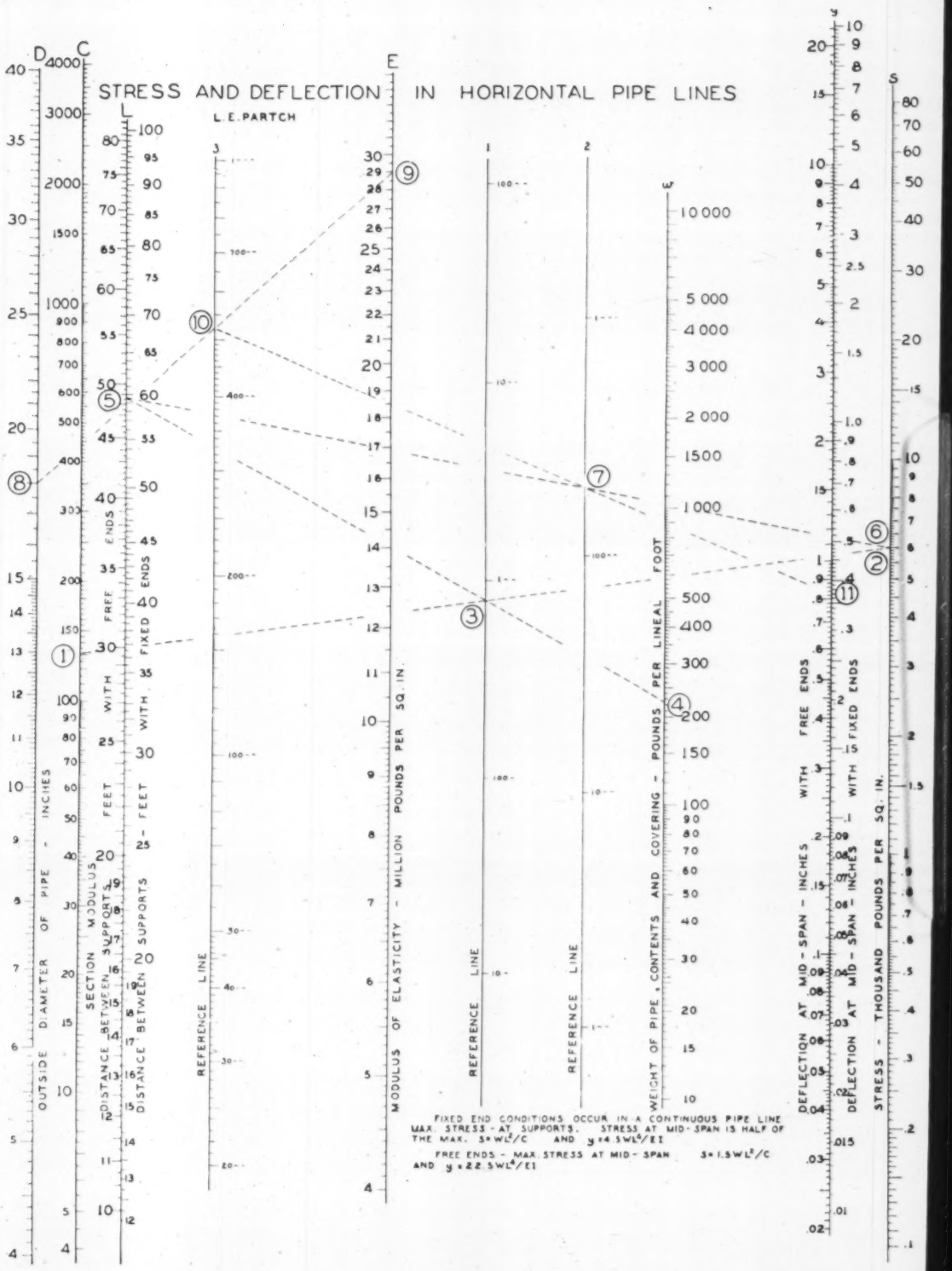
Given: Pipe size, 18 in. OD; wall thickness, 0.563 in.; section modulus *C*, 130.9; weight of pipe, 105 lb per ft; weight of water, 97.2 lb per ft; weight of covering, 22.8 lb per ft; total weight, 225 lb per ft. Assume that the total stress allowed by the Code for Pressure Piping for ASTM A106 Grade A pipe is 9600 psi and that the water pressure is 500 psi.

After graduation from the University of Michigan in 1917, the author had five years of mechanical design experience at the Ford Motor Co. (special machines and furnaces). He was then engaged in power plant and process design at Wyandotte Chemicals Corp. up to 1926, after which he spent a year at The Detroit Edison Co. on piping design. He then returned to Wyandotte in charge of steam production (where the "practical" side of piping was observed). He is presently with Giffels and Vallet, consulting engineers, on power plant design.

This pressure sets up a longitudinal stress of 500 × 224 / 30.85 = 3600 psi (where 224 sq in. is the cross-sectional flow area, and 30.85 sq in. is the cross-sectional metal area of the pipe). This leaves a difference of 6000 psi for stress due to bending set up by the supports.

Starting with the *C* and *S* scales on the chart, determine a point on reference line 1. With a load of 225 lb per lineal ft and the point on reference line 1, read the span *L*, 48.2 ft for free ends, or 59.5 ft for the span with fixed end conditions of a continuous line. This last figure must be used with discretion and is true only when the supports are perfectly lined up for equal loads. This caution also applies to "free end" span length for the reason that a support may accidentally drop its load, so that the span is increased up to a limit of two of the original spans. Where there is a possibility of an accident the practical span is therefore approximately 25 ft. Short spans result in lower stress.

Assuming, however, that the academic figures are accepted, the deflection may be determined. The modulus of elasticity *E* is 29,000,000 and the outside diameter *D* is 18. These values establish a point on reference line 3. Then with stress *S* at 6000 psi and span *L* of 48.2 establish a point on reference line 2. This point and the point on reference line 3 give the deflection of 0.8 in. for a free end condition and 0.37 in. for fixed end. The practical pitch for drainage is five times the possible deflection, or 4 in. in 48.2 ft for free ends and 1.85 in. in 59.5 ft for fixed ends.


STRESS AND DEFLECTION IN HORIZONTAL PIPE LINES
L. E. PARTCH
D
C
E
L
OUTSIDE DIAMETER OF PIPE - INCHES
SECTION MODULUS
DISTANCE BETWEEN SUPPORTS - FEET
WITH FREE ENDS
WITH FIXED ENDS
REFERENCE LINE
MODULUS OF ELASTICITY - MILLION POUNDS PER SQ. IN.
WEIGHT OF PIPE, CONTENTS AND COVERING - POUNDS PER LINEAL FOOT
DEFLECTION AT MID-SPAN - INCHES
STRESS - THOUSAND POUNDS PER SQ. IN.
FIXED END CONDITIONS OCCUR IN A CONTINUOUS PIPE LINE
MAX. STRESS - AT SUPPORTS. STRESS AT MID-SPAN IS HALF OF THE MAX. S = WL²/C AND y = 4.5WL⁴/EI
FREE ENDS - MAX. STRESS AT MID-SPAN S = 1.5WL²/C AND y = 22.5WL⁴/EI

# QUESTION of the Month

WHAT TYPE OR types of air conditioning systems would be most practical and satisfactory for the top 20 floors of an existing 21 story building? That's the question asked by "G.B." recently; his query was published in HPAC, and answers were invited.

Supplementing previously published comment on the problem, "H.W." suggests this month that full consideration be given to the use of self-contained units, with window units here and there throughout the building as needed.

## SUGGESTS UNIT SYSTEM FOR 21 STORY BUILDING

IF I WERE the owner of that 21 story office building described in "G.B.'s" recent Question of the Month, I would decide to air condition it with self-contained units of 3 and 5 hp capacity (with possibly a few 10 hp units), supplemented with window units here and there. Short runs of ducts would be used to deliver the air to enclosed offices; general office space would require no ducts. I think he would find that this would make a good practical system, easy to install quickly, flexible in control, and low in installation cost.

An air conditioning system is only as good as the tenants think it is. It is never possible to satisfy all of them—so one strives for as high a percentage as possible. The owner cannot only make his tenants comfortable but he can avoid a lot of discomfort for himself by selecting a system to start with that is flexible in installation and in operation.

Perhaps the ideal method would be one offering each tenant an individual system which would permit him to have just what he wanted all the time. Such a method could be made up of window units or room units of some kind, properly sized and operated to meet every requirement. This method has been used with a high degree of satisfaction.

But the method I suggest doesn't go quite this far. It compromises somewhat by combining the offices in groups of three to six—combining those naturally that have the same or similar load characteristics. This isn't quite as ideal as individual units for the offices.

Why do I believe that this combination of self-contained units should be the method selected? There are several reasons but two of the best are: (1) All tenants don't like the same comfort conditions, and this scheme provides the necessary flexibility. (2) Variations in the requirements, due principally to the radiant heat of the sun—which is variable in direction and intensity—are easily met.

All we need to say about the No. 1 reason is that people just don't always like the same thing, no matter what it is. When it comes to comfort, two people in the same room may prefer temperatures as far apart as 5 or 6 deg. So one tenant may want one thing and another something else. He can get it with the type of unit system suggested.

As for the No. 2 reason, there are things other than the sun heat that cause the load requirements to vary—such things as wind direction and the variable internal heat from people, lights and power consumption. But the variable sun heat alone is enough to cause all sorts of trouble because the difference between sun and shade on an exterior wall with glass is enough to make a difference of 6 to 8 deg in the room temperature. A number of small units can meet this condition.

One nice thing about this proposed method is that it can be done easily and it can be done quickly. It can be done one floor at a time. Doing one floor, or a few, at a time has the advantage, too, of permitting one to spread the investment cost over a period of two or three years.

This proposed method also lends itself to tenant financing very nicely—the landlord furnishing part of the overall system (things such as power, water and drain lines) and the tenants furnishing the rest. In this way a tenant isn't forced to have air conditioning if he doesn't want it and still it's available to him at a reasonable cost if he does want it. Strange as it may seem, for one reason or another, all tenants don't want air conditioning and this plan affords a solution for this situation.

Another favorable point to consider is that this proposed plan permits additional capacity to be added later without a major alteration to the whole system. Frequently, after a system is installed, the air conditioning load in some spaces is increased, because of something that has been added. With this proposed plan of a combination of units you can simply add one or more units and you have the solution.

### Facilitates Partition Changes

Consider, too, the problems involved when the time comes to rearrange partitions to meet the demands of new tenants or even the new demands of old tenants. Always, after a system has been carefully designed and installed to fit the building as is, someone wants a different office layout and this means a certain amount of alterations to the air conditioning system—alterations which can be made comparatively easily with a combination of units. This problem is the source of a lot of air conditioning complaints—complaints from tenants who are in an air conditioned space for which the system wasn't designed.

Outside air for ventilation should be furnished in ample quantity in some positive manner. For this proposed system made up of a combination of units, it is usually best to use some of the units for drawing in all outside air and delivering it to the other units through the spaces above false ceilings in the corridors. The recirculating units can either take the outside air

through a duct directly from the space over the corridor or indirectly after the outside air has been delivered into the corridor from several outlets. In the latter case, provision must be made to see that the thermostats in the recirculating units are subjected to only the return air from the air conditioned spaces.

Heating coils, if wanted, can be included as a part of these units. They should be furnished for the units handling all outside air but seldom are they needed for the units handling the recirculating air. For this system, as for others, it is advisable to continue to heat the building with the radiation already installed.

### About 30 Tons per Floor

So far, this proposed method of air conditioning for an existing building of 21 stories has been described in general terms. To be a little more specific, it appears that this building will require about 30 tons of air conditioning per floor and this might be done with six 5 hp self-contained units—or four 5 hp units plus three or four 3 hp units if more units are required to give better zoning. The offices along each exterior wall would be served by their own unit or units and the interior offices would be served by theirs. A corner office might be served by two of the units because corner offices usually have higher cooling requirements and an ample supply of cooling would be available from one unit or the other, no matter which of the two walls the sun was on.

Offices used for conferences could be provided with window units in order to supplement the cooling capacity from the unit serving its zone—the window unit to operate only when needed. This same plan could be used for any office that for some reason was loaded heavier than the average. With this combination of units—one serving the zone supplemented by smaller units serving the individual offices—a very flexible overall system is the result which can meet exceedingly well the variable requirements.

Two of the 5 hp units might be used to supply only outside air, with no recirculation, by drawing in their full air capacity from the outside and directing it through the space above the false ceiling in the corridors—the space from which the recirculating units draw their supply of outside air for ventilation. The outside air units not only supply the air for ventilation but cool and dehumidify it while doing so.

This combination of units should give about 12,000 cfm of air altogether for each floor, which would make nine changes per hour—a rate well within the range of good practice. The outside air quantity would be about 2400 cfm, 20 percent of the total, and sufficient to give nearly two complete changes per hour (which again is well within the range of good practice).

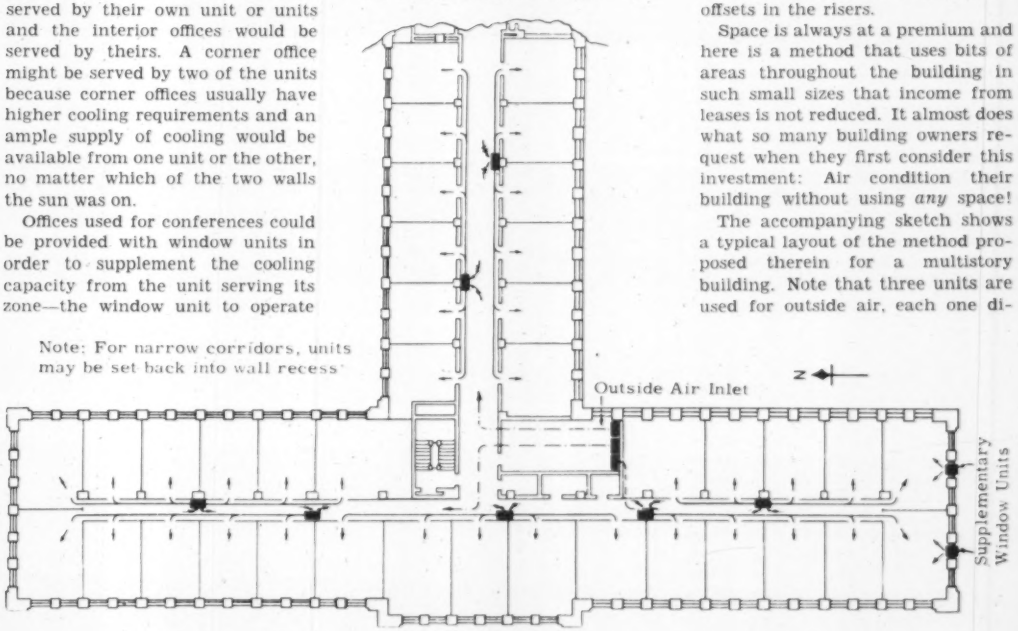
The location of the units would depend upon the layout of the offices. The two outside air units should be near an exterior wall, preferably in closet space or in some non-rentable area. The other units could be located in the corridors—if they were wide enough—or recessed into the corridor walls with the return air side facing the corridor and flush with the corridor walls. Conditioned air would be delivered through short runs of ducts to be installed in the enclosed space over the corridors, with side wall grilles for each office. Return air would pass from the offices to the corridors through sight-tight louvered openings in the doors and thence to the recirculating units.

The piping and power lines could be placed in the enclosed space over the corridors, the lines on one floor serving the units on the floor above. In this way, the false ceiling in the corridors conceals the ducts, the piping and the power lines. If vertical risers are to be used at several points, an effort should be made to locate the units in the same pattern on each floor in order to minimize long horizontal runs of piping or offsets in the risers.

Space is always at a premium and here is a method that uses bits of areas throughout the building in such small sizes that income from leases is not reduced. It almost does what so many building owners request when they first consider this investment: Air condition their building without using *any* space!

The accompanying sketch shows a typical layout of the method proposed therein for a multistory building. Note that three units are used for outside air, each one di-

**Typical layout for air conditioning a multistory building with self-contained units as suggested by "H.W." The dot-dash lines indicate distribution of outside air into the false ceiling**



recting its air supply to one of three corridors—actually, to the space over the false corridor ceiling. Also note well that offices of the same exposure are grouped together to afford the proper zoning and that the two corner offices on the south exposure have supplemental cooling with window units. In this case it was proposed that the piping and power lines be placed in the overhead space above the corridors.

At one time, perhaps, it was considered sufficient merely to dump a lot of cool air into the whole space and let the individual offices settle for what temperature they could get, making some attempt to balance out the temperatures by manually adjusting the air quantity to each office. But that time has gone forever; it is known now that the cooling requirements are different for different offices and for different times of the day and season and that something should be done to make the cooling capacity fit the cooling requirement for each and every office. Adjusting the air quantity by hand doesn't do it because one quantity may be needed in the morning and a different quantity in the afternoon—or whenever the weather changes from sunshine to clouds.

### Flexibility Needed in Spring and Fall

The proper zoning or flexibility of operations is needed most in the spring and in the fall, say, when the outside temperature is around 65 F and some of the offices require cooling (those that are subjected to the sun) and others require heating (those that are in the shade). It is nice to be able to turn on only part of the system to handle portions of the building during these two long seasons.

So many good things have been said about this proposed method of air conditioning that you may forget that right in the beginning I stated that this method was "low in installation cost". It isn't often that something which has so many advantages can also be so low in cost. That is an additional reason—and an excellent one—why I believe full consideration should be given to this combination-of-units method of air conditioning.—H. W.

## HOTEL INSTALLS AIR CONDITIONING UNITS

ONE HUNDRED and fifty-two additional remote type air conditioning units are being installed in the Hotel Sheraton, St. Louis, in 74 apartment suites (one of which is shown), 52 individual guest rooms, five private dining rooms and two function rooms. According to Robert B. Stocking, general manager of the Sheraton, these conditioners, with units previously installed, will provide air conditioning for 80 percent of the guest accommodations and 75 percent of the banquet facilities. The new installation is part of the Sheraton's program of modernization to provide increased comfort for its guests. Installation is being made by Natkin & Co., of St. Louis, engineers and contractors, under the supervision of Fred Kummer, of the Sheraton Corp.

**Two of the 152 remote type air conditioning units being installed at the Sheraton in St. Louis. (Courtesy General Electric Co.)**

## PIPING PRACTICES FOR OIL BURNING

ACCEPTED PRACTICE for bringing oil from the tank to the burner in industrial and commercial oil burner installations was asked about by "S.G." in a question published in the March HPAC. I should like to describe our systems in answering this question.

They consist of several thousand feet of pipe, with storage capacity 360,000 gal, and consuming when in full production, approximately 16,000 gal per day. The system was started on small scale and grew to its present size due to gas shortages during the war. Though primarily a circulating two pipe system, we have several units operating off this system as if it were the one pipe type. Pipe shortages, and a little experimentation, caused this as "necessity is the mother of invention".

In our installations, we placed a pump at the oil storage, a pressure relief valve in the discharge of the pump being piped to storage. The relief valve regulates the maximum pressure of the system, the pressure and temperature at a group of burners being controlled at the firing zone with additional equipment.

Insurance companies require large oil storages to be as remote as possible from factories. Our storage in some tanks is 40 ft below and several hundred feet away from the burners. To place the pump at the burners would have required a booster pump between it and the source of oil. We achieved desired results by installing the pump adjacent to storage, providing a suction head rather than an impossible suction lift.

Operating pressure depends on type of burners, kind of oil, and method of control. Our processes require temperature control of plus or minus 5 deg in the 1800 deg range. If in the operation of either automatic or hand controls the temperature change is too great, lowering oil pressure will enhance control, by lowering temperature variations.—M.A.M.

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

# Theory of Earth Heat Exchangers for the Heat Pump

By L. R. Ingersoll*, F. T. Adler**, Madison Wis., H. J. Plass†, Stanford University, Calif., and A. C. Ingersoll††, Madison, Wis.

**SUMMARY—The theory of earth heat exchangers, particularly as applied to the heat pump, is developed for plane exchangers, cavities, long and short pipes and various pipe grids, for conditions of constant exchanger temperature and also of constant transfer rate. The effects of summer recovery, ice formation, moisture migration, and underground water movement are considered, and suggestions are made on methods of measuring soil conductivity constants.**

THE EARTH is the most-discussed source of heat for reverse-cycle heating because of availability, temperature, and other considerations. While the small pipe, either relatively isolated or in hairpin loops, is probably the most effective means for use in such heat extraction and is the one which has received most attention, theoretical or experimental, there are a number of other forms of exchangers which should be studied. These include the flat surface and flat plate, the large cavity or "buried cistern," pipes of various sizes, large and small, long and short, and various forms of pipe grids. Most of these have been discussed as possibilities by Kemler[1]. This paper is a brief presentation of the theory applying to these various forms together with a comparative study of their efficiencies, and includes a treatment of some phases of the subject which have hitherto had little discussion.

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†Research Assistant, Mechanical Engineering, Stanford University.
††Project Assistant, Engineering Experiment Station, University of Wisconsin.
[1]Exponent numerals refer to References.

No one knows better than the practical heat pump engineer the short-comings and inadequacies of the theory in this field. There are at least four difficulties encountered by theoretical treatment at the start, namely, (*a*) Lack of knowledge of the thermal conductivity and diffusivity of the soil in the given location; (*b*) The well-recognized fact that there is a moisture migration, from the warmer to the cooler regions in the soil, which improves conductivity near the exchanger (winter operation) and produces more favorable transfer conditions than calculated; (*c*) The underground water movement which obtains a larger heat transfer than would be calculated on a pure conduction basis; and (*d*) The ice formation about the pipe or other exchanger, with accompanying release of latent heat. To these items might be added at least two others, such as the periodic temperature variation which occurs to some depth below the ground surface, the effects of cyclic rather than continuous operation of the heat pump, and any possible *boundary layer* effect due to lack of intimate contact of the exchanger with the soil.

In presenting the accompanying theoretical discussion, the authors recognize these limitations. However, when it comes to a *comparison* of the various types of exchanger, consideration of item (*a*) is largely eliminated since it applies equally to practically all types of earth heat exchangers. Some treatment of

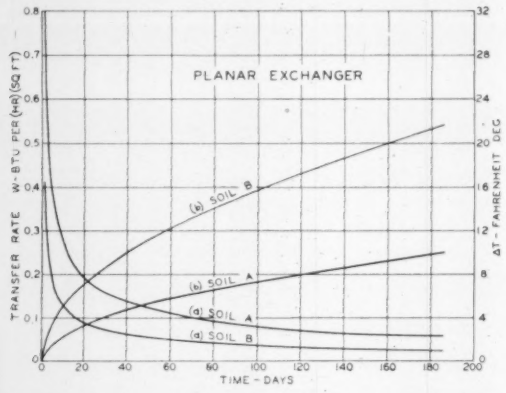


**Fig. 1—Transfer rate at constant exchanger surface temperature, and temperature differential at constant transfer rate, for planar exchanger***

*Curves (a) (left-hand scale): transfer rate $w$ for a temperature differential (i.e., temperature difference between surface of exchanger and initial soil temperature) of $\Delta T = 1$ deg. Curves (b) (right-hand scale): temperature differential $\Delta T$ for a transfer rate of $w = 1$ Btu per (hr) (sq ft). Soil constants: soil A, $k = 1.2$, $c = 0.45$, $\rho = 102$, $\alpha = 0.0261$; soil B, $k = 0.4$, $c = 0.3$, $\rho = 100$, $\alpha = 0.0133$.

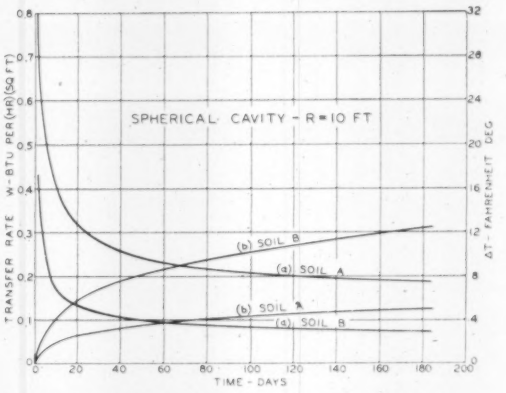


**Fig. 2—Transfer rate at constant exchanger surface temperature, and temperature differential at constant transfer rate, for spherical cavity exchanger***

*Curves (a) (left-hand scale): transfer rate $w$ for $\Delta T = 1$ deg. Curves (b) (right-hand scale): temperature differential $\Delta T$ for a transfer rate of $w = 1$ Btu per (hr) (sq ft). For soil constants see Fig. 1.

items (*b*), (*c*) and (*d*) is attempted in this paper. In further justification of theory it may be added that, while there have been a number of experiments with pipes, it may be some time before there are any experimental comparative studies of all the various types of exchanger; so for the present it is necessary to fall back on theory.

In the accompanying treatment two general cases are considered for each type of exchanger: (1) *constant surface temperature of the exchanger* and the consequent heat transfer as dependent on time, and (2) *constant heat transfer rate* and the resulting surface temperature calculated as a function of time. While the latter would appear to approximate more nearly the situation encountered in practical use—at least it is the heat transfer rate which is generally known or specified—it is frequently easier, experimentally, to meet the former conditions. The exchangers are treated as isolated in general and remote from ground surface effects, and the initial soil temperature is considered uniform. (For constant transfer rate with a small diameter pipe exchanger any departure from uniformity, such as that due to seasonal changes, can generally be taken into account by merely adding such departure from the mean temperature to the effect, *i.e.*, temperature change, produced by the exchanger). To take account of variations from these conditions would unduly extend the treatment; furthermore they have been considered in an earlier paper[2] on pipe exchangers, and on the basis of this an estimate of their effect can be reached. Likewise, for present purposes, the somewhat secondary effects of cyclic operation are neglected and only average transfer rates and temperatures are considered. As in the earlier paper, calculations are limited to two types of soil: (1) Soil A, a wet clay of high conductivity having the characteristics $k = 1.2$, $c = 0.45$, $\rho = 102$, $\alpha = 0.0261$ (these are to be considered, of course, only as effective overall values) and (2) Soil B, a moist soil of medium low conductivity ($k = 0.4$, $c = 0.3$, $\rho = 100$, $\alpha = 0.0133$).*

## Plane Surface or Flat Plate

Consideration is given here to a plane surface (heat flow perpendicular to the surface and in the positive $x$ direction only), or a flat plate (flow in both positive and negative $x$ directions) which is so large that edge effects can be neglected.

(*a*) *Constant Exchanger Surface Temperature.* This is one of the simplest cases. The equation from ref. 3 p. 90

$$w = \frac{k\Delta T}{\sqrt{\pi\alpha t}} \qquad (1)$$

is well known and has been ingeniously graphed by Raber, Boester and Hutchinson.[4]

*Sample calculations:* For a large plane surface in soil A, held at a constant temperature differential $\Delta T$** of 1 deg above or below initial soil temperature, the rate of heat transfer $w$ after 168 hr or one week is 0.323 Btu per (hr) (sq ft) and 0.111 after two months (see Fig. 1). For soil B the corresponding values are 0.151 and 0.051. The values would be the same for a flat plate transferring heat on both sides, but, for the same general dimensions, it would obviously have twice the area of flat surface and consequently twice the total heat transfer.

(*b*) *Constant Transfer Rate.* The equation here is

$$\Delta T = \frac{2w\sqrt{\pi t}}{k\sqrt{\pi}} \qquad (2)$$

*Tables of symbols are included at the end of this paper.

**The expression *temperature differential* $\Delta T$ is used throughout this paper as an abbreviation for $T - T_0$, *i.e.*, the difference between the temperature at the point under consideration (usually the surface of the exchanger) and the *initial* uniform soil temperature. It is obviously constant for case (*a*) and a function of time for case (*b*).

and is based on the flat plate equation[3] (p. 156; the factor of 2 discrepancy occurs because of the way the area is taken in this reference). In using either Equations 1 or 2 for a flat plate transferring heat on each side, $w$ is calculated as the total heat transfer divided by the total area of the two sides.

*Sample calculations:* For a large plane surface in soil A, with transfer rate $w$ of one Btu per (hr) (sq ft) (*i.e.*, total transfer of 600 Btu per hr for each 20 ft × 30 ft surface, or 1200 for a plate of this size), $\Delta T$ would be 1.97 deg after one week and 5.80 deg after two months, *vs.* 4.20 deg and 12.4 deg for soil B (see Fig. 1).

It is to be noted that *this temperature differential is proportional to the square root of the time.* Guernsey, Betz and Skau[5] have made calculations on a long-time (20 year) basis for one soil and have also treated the case of periodic flow.

## Spherical Cavity

The spherical cavity might well be called a *spherical exchanger*, but the term *cavity* expresses the condition better.

*(a) Constant Temperature of Cavity Surface.* The equation[3] (p. 143) which applies is

$$q = 4\pi k R \Delta T \left(1 + \frac{R}{\sqrt{\pi \alpha t}}\right) \quad (3)$$

*Sample calculations:* For a cavity of radius $R$ = 10 ft and $\Delta T$ = 1 deg the transfer rate for soil A is $q$ = 557 Btu per hr and $w$ = 0.443 Btu per (hr) (sq ft) after one week, and 288 and 0.229 respectively after two months. For soil B the corresponding values are 240 and 0.191; and 114 and 0.091 (see Fig. 2).

*(b) Constant Transfer Rate.* It can be shown that the temperature at a point in the medium distant $r$ from the center of a spherical cavity of radius $R$ ($r > R$) in which heat transfer with the medium is taking place at a constant rate $q$, differs from its initial value by an amount $\Delta T$ which is given by

$$\Delta T = \frac{q}{4\pi k r}\left\{\frac{2}{\sqrt{\pi}}\int_{\frac{r-R}{2\sqrt{\alpha t}}}^{\infty} e^{-\beta^2} d\beta - e^{\frac{r-R}{R}+\frac{\alpha t}{R^2}}\left[\frac{2}{\sqrt{\pi}}\int_{\frac{r-R}{2\sqrt{\alpha t}}+\frac{\sqrt{\alpha t}}{R}}^{\infty} e^{-\beta^2} d\beta\right]\right\} \quad (4)$$

When $r = R$, Equation 4 reduces to

$$\Delta T = \frac{q}{4\pi k R}\left\{1 - e^{\frac{\alpha t}{R^2}}\left[\frac{2}{\sqrt{\pi}}\int_{\frac{\sqrt{\alpha t}}{R}}^{\infty} e^{-\beta^2} d\beta\right]\right\} \quad (5)$$

*Sample calculations:* For the same cavity as used in (*a*) and for a transfer rate $w$ ($w = q/4\pi R^2$) of one Btu per (hr) (sq ft) of cavity surface the temperature differential $\Delta T$ after one week (soil A) is 1.65 deg and after two months 3.65 deg. For soil B the values are 3.70 deg and 8.80 deg (see Fig. 2).

It may be noted that an actual steady state of temperature is eventually attained in the spherical cavity case. (In either the infinite planar exchanger or the long isolated pipe there is no true steady state.) In the example given it would be reached approximately in a few years, when $\Delta T$ would be

$$\Delta T = \frac{q}{4\pi k R} \quad (5a)$$

This gives $\Delta T$ = 8.33 deg for soil A and 25 deg for soil B. This would mean, from Equation 3, a transfer rate (for $\Delta T$ = 1 deg) of $q$ = 150.8 Btu per hr, or $w$ = 0.120 Btu per (hr) (sq ft) for soil A and corresponding values of 50.2 and 0.040 for B.

These same general considerations apply to any cavity of roughly spherical (or even cubical) shape, *e.g.*, a "buried cistern". As will be shown, the cavity (also the flat plate) is a relatively inefficient exchanger. The presence of corners and edges, as in the cubical shape, does not increase its efficiency markedly; this may be estimated by comparing its efficiency in steady state operation with that of a sphere of equal volume (see Polya[6]).

## Pipes

*(a) Constant Surface Temperature.* The theory of this case has been worked out by Jaeger[7] and others (see also Carslaw and Jaeger[8] p. 283). The rate of heat exchange $Q$ Btu per (hr) (linear ft) for a long isolated pipe held at a constant temperature $\Delta T$ above or below the

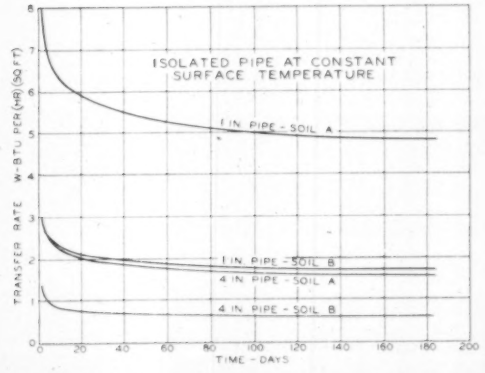
ISOLATED PIPE AT CONSTANT SURFACE TEMPERATURE
1 IN. PIPE - SOIL A
1 IN. PIPE - SOIL B
4 IN. PIPE - SOIL A
4 IN. PIPE - SOIL B
TRANSFER RATE w - BTU PER (HR) (SQ FT)
TIME - DAYS

**Fig. 3—Transfer rate for long isolated pipe exchanger at constant surface temperature[a]**

[a]Temperature differential $\Delta T$ = 1 deg. For soil constants see Fig. 1.

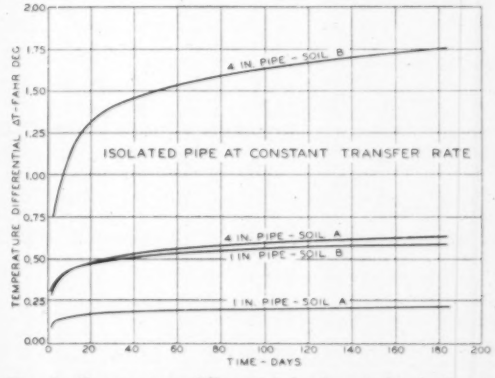
ISOLATED PIPE AT CONSTANT TRANSFER RATE
4 IN. PIPE - SOIL B
4 IN. PIPE - SOIL A
1 IN. PIPE - SOIL B
1 IN. PIPE - SOIL A
TEMPERATURE DIFFERENTIAL ΔT - F&HR DEG
TIME - DAYS

**Fig. 4—Temperature differential for long isolated pipe exchanger at constant transfer rate[a]**

[a]Transfer rate $w$ = 1 Btu per (hr) (sq ft). For soil constants see Fig. 1.

**Table 1—Values of $F(z)$ (see Equation 8)**

| $z$ | $F(z)$ | $z$ | $F(z)$ | $z$ | $F(z)$ | $z$ | $F(z)$ |
|---|---|---|---|---|---|---|---|
| 0.01 | 38.508 | 0.50 | 7.751 | 40 | 2.539 | 4000 | 1.350 |
| 0.02 | 28.096 | 0.60 | 7.288 | 50 | 2.440 | 5000 | 1.319 |
| 0.03 | 23.474 | 0.70 | 6.926 | 60 | 2.363 | 7500 | 1.266 |
| 0.04 | 20.716 | 0.80 | 6.634 | 80 | 2.251 | 10000 | 1.233 |
| 0.05 | 18.829 | 1.00 | 6.180 | 100 | 2.172 | 15000 | 1.184 |
| 0.06 | 17.433 | 1.2 | 5.844 | 120 | 2.114 | 25000 | 1.131 |
| 0.07 | 16.351 | 1.5 | 5.467 | 150 | 2.042 | | |
| 0.08 | 15.472 | 2.0 | 5.029 | 200 | 1.956 | | |
| 0.09 | 14.744 | 2.5 | 4.726 | 250 | 1.893 | | |
| 0.10 | 14.130 | 3.0 | 4.500 | 300 | 1.846 | | |
| 0.12 | 13.135 | 4 | 4.174 | 400 | 1.775 | | |
| 0.14 | 12.361 | 5 | 3.947 | 500 | 1.721 | | |
| 0.16 | 11.737 | 6 | 3.776 | 600 | 1.683 | | |
| 0.18 | 11.217 | 8 | 3.529 | 800 | 1.622 | | |
| 0.20 | 10.777 | 10 | 3.354 | 1000 | 1.578 | | |
| 0.25 | 9.916 | 12 | 3.224 | 1200 | 1.543 | | |
| 0.30 | 9.277 | 15 | 3.074 | 1500 | 1.502 | | |
| 0.35 | 8.779 | 20 | 2.898 | 2000 | 1.454 | | |
| 0.40 | 8.373 | 25 | 2.774 | 2500 | 1.418 | | |
| 0.45 | 8.037 | 30 | 2.678 | 3000 | 1.393 | | |

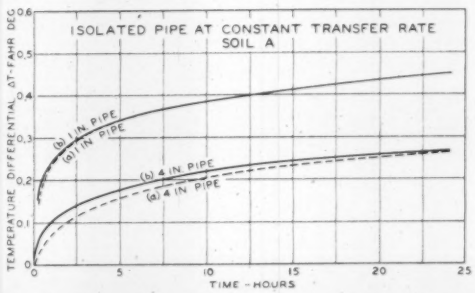


**Fig. 5—Comparison of results of computations from the line source equation and the Jaeger integrals of the temperature differential for long isolated pipe exchanger at constant transfer rate[a]**

[a]Transfer rate $Q' = 1$ Btu per (hr) (linear ft). The approximate curves (a) (dashed line) are obtained with the line source Equation 9; the exact curves (b) are computed from Table 2 of the Jaeger integrals. For soil constants see Fig. 1.

initial soil temperature is given by

$$Q' = k\Delta T F(z) \quad \cdots\cdots (6)$$

and the rate $w$, Btu per (hr) (sq ft) by

$$w = \frac{k\Delta T}{2\pi R} F(z) \quad \cdots\cdots (7)$$

where $z = \alpha t / R^2$ and

$$F(z) = \frac{8}{\pi} \int_0^\infty \frac{e^{-z\beta^2}}{J_0^2(\beta) + Y_0^2(\beta)} \frac{d\beta}{\beta} \quad \cdots\cdots (8)$$

Values of $F(z)$, adapted and extended from Jaeger and Clarke[6], are given in Table 1.

*Sample calculations:* For a 4 in. (O.D.) pipe* (i.e., $R = 0.167$ ft) in soil A, with $t = 24$ hr and $\Delta T = 1$, values of $z$ and $F(z)$ will be: $z = 22.5$ and $F(z) = 2.83$. Then $Q' = 3.40$ Btu per (hr) (linear ft), or $w = 3.23$ Btu per (hr) (sq ft). For $t = 731$ hr, $Q' = 1.98$ and $w = 1.88$ (see Fig. 3).

(b) *Constant Transfer Rate.* The simplest theory for this is the line source equation[2],

$$\Delta T = \frac{Q'}{2\pi k} \int_{\frac{r}{2\sqrt{\alpha t}}}^\infty \frac{e^{-\beta^2}}{\beta} d\beta = \frac{Q'}{2\pi k} I\left(\frac{r}{2\sqrt{\alpha t}}\right) \quad \cdots\cdots (9)$$

but in cases where the time is too short or the pipe diameter too large (in general when $\alpha t / R^2 < 20$) the use of the line source equation involves appreciable error. Jaeger[7] has given an equation, which, while difficult to evaluate, covers all cases (see also ref 8 p. 283). For a pipe transferring heat at a rate of $Q'$ Btu per (hr) (linear ft) the temperature differential $\Delta T$ between the initial soil temperature and the point under consideration at or near the pipe is given by

$$\Delta T = \frac{Q'}{k} G(z,p) = \frac{2\pi R w}{k} G(z,p) \quad \cdots\cdots (10)$$

*where*

$$G(z,p) = \frac{1}{\pi^2} \int_0^\infty \frac{e^{-\beta^2 z} - 1}{J_1^2(\beta) + Y_1^2(\beta)} \left\{ J_1(p\beta) Y_0(\beta) - J_0(p\beta) Y_1(\beta) \right\} \frac{d\beta}{\beta^2} \quad \cdots\cdots (11)$$

In these equations $z = \alpha t / R^2$ as above, and $p = r/R$; *i.e.*, for $p = 5$ the point whose temperature is sought is distant $5R$ from the center of the pipe. The values for $p = 1$ apply to the pipe surface. The values of $G(z,p)$ have been computed for a wide range of values of $z$ (see ref. 8, p. 283 for values up to $z = 10$ for $p = 1$) and for $p = 1,2,5,10$. These are given in Table 2.

*Sample calculations:* For the same 4 in. O. D. pipe and soil A used in calculations under previous item (a), with $Q' = 1$ Btu per (hr) (linear ft) and $t = 5.34$ hr, values of $z$ and $G(z, 1)$ will be $z = 5$ and $G(z, 1) = 0.217$. The pipe surface temperature change would accordingly be $\Delta T = 0.181$ deg. For $w = 1$ this figure would be 0.190 deg (see Figs. 4 and 5). For a distance of $5 \times 0.167 = 0.833$ ft from the center of the pipe, $\Delta T = 0.0127$ deg for $Q' = 1$.

**Table 2—Values of $G(z,p)$ (see Equation 11)**

| $z$ | $G(z,1)$ | $G(z,2)$ | $G(z,5)$ | $G(z,10)$ |
|---|---|---|---|---|
| 0.10 | 0.049 | | | |
| 0.20 | 0.067 | | | |
| 0.30 | 0.080 | | | |
| 0.40 | 0.090 | | | |
| 0.50 | 0.099 | | | |
| 0.60 | 0.107 | | | |
| 0.70 | 0.113 | | | |
| 0.80 | 0.118 | | | |
| 1.00 | 0.128 | 0.035 | 0.001 | 0.000 |
| 1.20 | 0.137 | | | |
| 1.5 | 0.148 | | | |
| 2.0 | 0.163 | | | |
| 2.5 | 0.175 | | | |
| 3.0 | 0.186 | | | |
| 4.0 | 0.203 | | | |
| 5 | 0.217 | 0.112 | 0.0153 | 0.0001 |
| 6 | 0.228 | | | |
| 8 | 0.247 | | | |
| 10 | 0.263 | 0.155 | 0.0388 | 0.0024 |
| 12 | 0.275 | 0.167 | 0.0470 | 0.0042 |
| 15 | 0.291 | 0.182 | 0.0580 | 0.0072 |
| 20 | 0.312 | 0.203 | 0.0736 | 0.0129 |
| 25 | 0.328 | 0.219 | 0.0866 | 0.0188 |
| 30 | 0.342 | 0.232 | 0.0979 | 0.0246 |
| 50 | 0.380 | 0.271 | 0.132 | 0.0460 |
| 100 | 0.433 | 0.323 | 0.181 | 0.0842 |
| 500 | 0.560 | 0.449 | 0.304 | 0.197 |
| 1000 | 0.614 | 0.504 | 0.359 | 0.250 |
| 5000 | 0.742 | 0.632 | 0.486 | 0.376 |
| 10000 | 0.797 | 0.687 | 0.541 | 0.431 |
| 25000 | 0.870 | 0.760 | 0.614 | 0.504 |

In Fig. 5 are plotted curves calculated on the basis of the line source equation (Equation 9) and also of the more exact Jaeger integral (Equation 11) evaluated in

*For simplicity and because of the variety of materials and sizes used in exchanger pipes, diameters are expressed in whole numbers of inches, rather than standard pipe sizes.

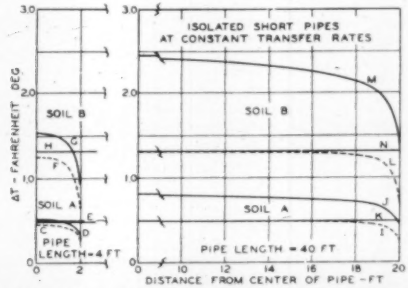
ISOLATED SHORT PIPES AT CONSTANT TRANSFER RATES
ΔT - FAHRENHEIT DEG
SOIL B
SOIL A
PIPE LENGTH=4 FT
PIPE LENGTH = 40 FT
DISTANCE FROM CENTER OF PIPE - FT

**Fig. 6—Temperature differential for isolated short pipe exchangers at constant transfer rate[a]**

[a]Transfer rate $Q' = 1$ Btu per (hr) (linear ft). Diameter of pipe, 2 in. Length, 4 ft and 40 ft (with infinite pipe for comparison). Curves give temperature differential for points on pipe surface at various distances from middle of pipe for the following conditions: C, time 168 hr; D, infinite time, *i.e.*, steady state; E (straight line), infinite pipe, 168 hr; F, time 168 hr; G, steady state; H, infinite pipe, 168 hr; I, time 168 hr; J, steady state; K, infinite pipe (same as E); L, time 168 hr; M, steady state; N, infinite pipe (same as H). For soil constants see Fig. 1.

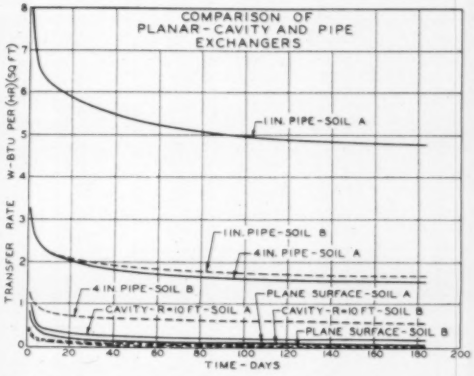


**Fig. 7—Comparison of transfer rates for planar, spherical cavity, and long isolated pipe exchangers at constant surface temperature[a]**

[a]Temperature differential $\Delta T = 1$ deg. For soil constants see Fig. 1.

Table 2. It is to be particularly noted that, with ordinary soils and *for pipes less than 4 in. in diameter and times longer than one day, the simple line source equation* (see ref. 2, or ref. 3, p. 253, for tables of this integral) *gives results sufficiently accurate for practical purposes.* The error does not exceed about 2 percent under these conditions. More exactly, the criterion for this small error or less is $\alpha t/R^2 > 20$.

This criterion also holds in general for the use of the line source equation for points at a distance from the pipe, $R$ still being the radius of the *pipe*. This equation can therefore be used to find the temperature 20 in. from the center of a 4 in. pipe in soil A after 24 hr (*i.e.*, $\alpha t/R^2 = 22.5$) but the Jaeger integral would be needed for an 8 in. pipe for this distance and time. For $r > 10R$ the Jaeger integral (Equation 11) is not evaluated, so the line source equation is the only simple solution readily available without further numerical work (the limits of its validity to be kept in mind).

(c) *Short Pipes.* The preceding theory applies exactly only to the infinitely long pipe. It is important accordingly to know something of the magnitude of the error involved when it is applied to pipe lengths in common use.

The theory of the finite pipe for the case of constant transfer rate is not hard to derive. The temperature differential at a distance $r$ from a point source at time $t$ after it starts to emit or absorb $q$ units of heat per unit of time is given (ref. 3, pp. 144, 146) by

$$\Delta T = \frac{q}{4\pi kr} \cdot \frac{2}{\sqrt{\pi}} \int_{\frac{r}{2\sqrt{\alpha t}}}^{\infty} e^{-\beta^2} d\beta \qquad (12)$$

For a line source in the $z$ direction made up of such points, emitting $Q'$ heat units per unit of time per unit of length, the temperature differential at a distance $R$ (*e.g.* on the pipe surface) from this line is

$$\Delta T = \frac{Q'}{4\pi k} \int_{z_1}^{z_2} \frac{dz}{\sqrt{z^2+R^2}} \int_{\frac{\sqrt{z^2+R^2}}{2\sqrt{\alpha t}}}^{\infty} \frac{2}{\sqrt{\pi}} e^{-\beta^2} d\beta \qquad (13)$$

where the pipe extends from $z_1$ to $z_2$. When applied to pipe surface temperatures, this expression, like the line source equation, is reasonably accurate only for $\alpha t/R^2 > 20$, as would be true for most practical cases.

For $(\sqrt{z^2+R^2}/2\sqrt{\alpha t}) < 1$, Equation 13 can be put in the form

$$\Delta T = \frac{Q'}{4\pi k} \left\{ \log_e \frac{z_2+\sqrt{z_2^2+R^2}}{z_1+\sqrt{z_1^2+R^2}} - \frac{1}{\sqrt{\pi \alpha t}} \left[ \left(1 - \frac{R^2}{12\alpha t} + \frac{R^4}{160\alpha^2 t^2} - \cdots\right)(z_2 - z_1) + \left(-\frac{1}{12\alpha t} + \frac{2R^2}{160\alpha^2 t^2} - \cdots\right)\left(z_2^3 - z_1^3\right)/3 + \left(\frac{1}{160\alpha^2 t^2} + \cdots\right)\left(z_2^5 - z_1^5\right)/5 + \cdots \right] \right\} \qquad (14)$$

For $R < \frac{L_p}{10}$ and $L_p < \sqrt{\alpha t}$ * ($L_p$ = pipe length) as would frequently be the case, Equation 14 reduces to the following simple design equation for pipe surface temperatures near the middle of a short pipe,

$$\Delta T = \frac{Q'}{4\pi k} \left( 4.6 \log_{10} \frac{L_p}{R} - \frac{L_p}{\sqrt{\pi \alpha t}} \right) \qquad (15)$$

This gives, for example, the temperature at the surface in the middle of a 2 in. pipe 4 ft long in soil A, after a few days of operation, with negligible error.

While there is no steady state of temperature for the infinite isolated pipe there is such a state for the finite pipe—although it may take a long time to reach this state—and its value is given at once by putting $t = \infty$ in Equation 13 whence

$$\Delta T = \frac{Q'}{4\pi k} \int_{z_1}^{z_2} \frac{dz}{\sqrt{z^2+R^2}} = \frac{Q'}{4\pi k} \log_e \frac{z_2+\sqrt{z_2^2+R^2}}{z_1+\sqrt{z_1^2+R^2}} \qquad (16)$$

The curves of Fig. 6 show the results of such calculations made either by graphical solution of Equations 13 and 16 or by the use of Equations 14 or 15, for points on the surface of a 2 in. pipe ($R$ =

*This is for an error of about 1 percent. For $L_p = 2\sqrt{\alpha t}$ the error is of the order of 4 percent, and for $L_p = 3\sqrt{\alpha t}$, about 9 percent.

0.0833 ft) for soils A and B. It will be noted (curves I or L) that for the 40 ft pipe (except for the last foot of pipe) the temperatures are practically the same as for the infinite pipe (curves K or N). This means that *the infinite pipe theory may in general be applied with negligible error to the long pipes usually used.* It is also to be noted that while the 4 ft long pipe comes within 20 percent of steady state temperatures after one week of operation, the 40 ft pipe would require a very much longer time for such attainment.

With the aid of another integration, Equation 13 can be modified to apply to the case of the small flat plate exchanger.

While there is no steady state for the isolated infinite pipe, there is, however, a steady state for an infinite pipe, *with constant transfer rate*, buried below a ground surface held at constant temperature. If the ground surface temperature is the initial soil temperature, the use of Equation 9 gives this steady state temperature at once. The value of this integral for large $t$ is simply $\log_e \frac{2\sqrt{\alpha t}}{r}$ (see ref. 3, p. 253) so for a pipe buried a distance $s$ below the surface, $\Delta T$ (if the radius of the pipe is small relative to $s$) for the steady state, is

$$\Delta T = \frac{Q'}{2\pi k}\left(\log_e \frac{2\sqrt{\alpha t}}{r} - \log_e \frac{2\sqrt{\alpha t}}{2s}\right)$$

$$= \frac{Q'}{2\pi k} \log_e \frac{2s}{r} \qquad (16a)$$

Equation 16*a* is frequently used, especially for buried cables, but its derivation by the usual method is by no means simple (see ref. 10, pp. 333-4).

### Comparison of Exchangers

For comparison purposes, the values of $w$, the transfer rate per square foot of area, for the planar exchanger, spherical cavity, and two sizes of pipe have been plotted together in Fig. 7. The superiority of the pipe exchanger is at once evident, not only because its transfer rate is large but also because the reduction of heat transfer rate with time is less. It is also to be noted that the small pipe has a higher transfer rate than the larger one.

The comparisons of Fig. 7 are all on the basis of the transfer rate *per square foot of area* of the various exchangers. If it is desirable to compare the two sizes of pipe on the basis of the transfer rate $Q'$ *per linear foot*, it is only necessary to multiply the ordinates by $\pi$ times the pipe diameter. From this it may be concluded that $Q'$ for the 4 in. pipe is from 1.29 (soil A, 6 months) to 1.68 (soil B, 1 day) larger than for the 1 in. pipe. This indicates the desirability of backfilling around a small pipe in a trench with some material of as high conductivity as possible. It also goes without saying that close adherence of the soil to the pipe is of the highest importance.

### Pipe Grids

Most exchangers in actual use or under test are pipe grids of various types. Exact calculations are difficult in most cases but some general observations can be made.

(*a*) *Hairpin Loops.* These have been treated in the previous paper[2]. The curves show that the single loop still has a good efficiency per pipe. Applications of the same equations, however, will show that with the addition of more pipes to the same trench the efficiency falls off markedly. This is well shown in Fig. 8 where the temperature differential is plotted for an isolated 1 in. pipe, for each pipe in a hairpin loop with the pipes 30 in. apart, and for each pipe in two such loops 30 in. apart. In the latter case each pipe is 30 in. distant from two similar pipes absorbing heat at 1 Btu per (hr) (linear ft) and 42.4 in. from a third. The temperature of any one pipe can accordingly be calculated as in the previous paper[2] as the sum of the effects of line sources at distances of 0.5 in., 30 in., 30 in., and 42.4 in.

(*b*) *Flat grids.* A closely-spaced (perhaps a foot or so between pipes) flat grid becomes effectively a flat plate, whose treatment has already been given. It has occasionally been suggested that pipes might be wound about the foundation of a house (with suitable insulation next to the wall) or located under the basement floor. Equations 1 and 2 would show that such a grid is relatively inefficient and it is, moreover, open to special serious practical objections based on freezing of ground.

(*c*) *Star Grids.* In such a grid, the loops, each more or less in a vertical plane, radiate out like the points of a star from a central header. Success could not be predicted for such a grid because of the small volume of soil with which it is concerned. Such reports as are available indicate that such grids are unsatisfactory.

(*d*) *Pipe Helixes.* A closely-wound helix becomes, effectively, a pipe of the diameter of the helix. The considerations brought out in the previous section would indicate that this is likely to be a waste of pipe and little more effective than a single pipe of the same overall length and diameter as the helix.

(*e*) *Pipe with Laterals.* Since the end of a pipe operates at a smaller temperature differential (see Fig. 6) for a given transfer rate than the rest of the pipe, a long pipe with a large number of short (*e.g.*, 3 ft) laterals might have possibilities.

(*f*) Vertical *Pipe Grid.* Wagley[11] and Randolph have been testing[‡] an ingenious grid made up of some forty 10 ft lengths of 3 in. (3.5 in. O.D.) iron pipe installed vertically with the aid of a pole-setting digger. These were arranged in four rows of 10 pipes each, the alternate rows being staggered, with a spacing between the pipes of 9 ft 3 in. This meant that, except at the ends of the rows, each pipe in the two inside rows was at a distance of 9 ft 3 in. from each of six similar pipes. The plot of ground used was approximately 40 × 75 ft.

A series of measurements had been made with thermocouples at different depths in the ground before the pipes were installed. These gave an annual temperature range of 34 deg at a depth of 2 ft and 4 deg at 22 ft. From these measurements, using the equation[1] (p. 47),

$$T_x = 2T_0 e^{-x\sqrt{\pi/\alpha P}} \qquad (17)$$

which expresses the range at any depth $x$ in terms of the surface range $2T_0$ ($T_0$ = amplitude or half temperature range at surface) the diffusivity $\alpha$, and the period $P$ of 8766 hr (one year), the diffusivity of this soil may be calculated as 0.028. (It is unnecessary to know the surface range because measurements were taken at two different depths). Assuming average values for $c$ as 0.30 and $\rho$ as 105 the value of $k$ is 0.88. Calculations based on temperature lag for different depths give practically the same value for $\alpha$. These values will therefore be used as the thermal constants of this soil.

In a recent all-winter test heat was extracted at an average rate of about 35 Btu per (hr) (foot length of the 3.5 in. pipe) for a period of some months, and in 3 months this resulted in a 30 deg drop at the pipe surface, bringing

‡Results of tests used by permission.

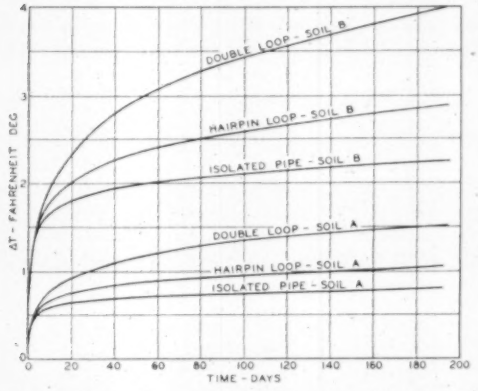
DOUBLE LOOP - SOIL B
HAIRPIN LOOP - SOIL B
ISOLATED PIPE - SOIL B
DOUBLE LOOP - SOIL A
HAIRPIN LOOP - SOIL A
ISOLATED PIPE - SOIL A
ΔT - FAHRENHEIT DEG
TIME - DAYS

**Fig. 8—Temperature differential for isolated pipe, hairpin loop, and double loop at constant transfer rate[a]**

[a]Transfer rate $Q' = 1$ Btu per (hr) (linear ft). Pipes 1 in. diameter, 30 in. apart in loop and the two loops 30 in. apart.

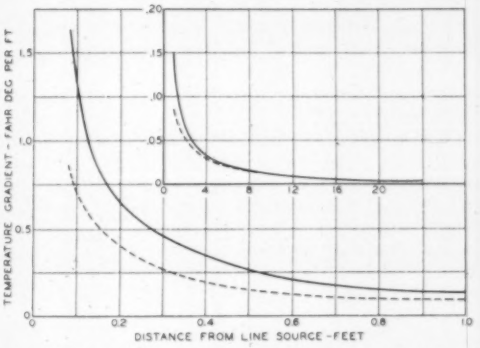


**Fig. 9—Effect of increased conductivity, due to moisture migration, on the temperature gradient in the soil near a line source[a]**

[a]Transfer rate $Q' = 1$ Btu per (hr) (linear ft). Solid line: temperature gradient near a line source, *i.e.*, small pipe, in soil A. Dotted line: temperature gradient in same soil with conductivity near pipe increased by moisture migration.

it several degrees below freezing. Using the given soil constants, the temperature differential for an isolated pipe of this size is at once calculated from Table 2 and Equation 10 (or from Equation 9 if desired) as 27.7 deg. However, since each pipe in this test was only 9.25 ft distant from 3.7 (average) other pipes, calculations (Equation 9 must be used here) give an additional drop of 9.3 deg making a total drop of 37 deg. When it is remembered that no account has been taken of the latent heat released when the freezing point is reached, also that moisture migration in the soil will improve the conductivity near the pipes and hence lessen the temperature drop, it must be considered that the calculation is in satisfactory agreement with the measured value of 30 deg.

In the tests reported so far only half of the total grid of 40 pipes has been used. When all are in operation at this same rate a few degrees greater temperature drop may result from the proximity, for any one pipe, of more neighboring pipes.

## Ground Temperature Recovery

When a large block of soil is chilled by heat extraction in winter some 30 deg or more below its original temperature, as in the installation just described, the question of its temperature recovery in summer becomes an important one. Some approximate calculations may be made assuming that such recovery will result from the heat inflow at the ground surface and from the surrounding soil, and neglecting any heat returned as a result of summer operation.

A block of soil is assumed to be 40 × 75 ft in area and 14 ft deep, and having the thermal conductivity constants ($k = 0.88$, $\alpha = 0.028$), chilled to $\Delta T$ below the initial soil temperature (which is perhaps 50 F) and in contact with soil at this original temperature. Assume also that the upper surface is held at this 50 F temperature. The temperature recovery which might be expected in five months is desired at a point in the middle of the long dimension of the block 3 ft from the longitudinal center line and 10 ft below the surface.

The equation which applies here[a] (p. 181) is

$$\frac{\Delta' T}{\Delta T} = \frac{1}{8}\left(\frac{2}{\sqrt{\pi}}\right)^3 \int_{-37.5p}^{37.5p} \int_{-23p}^{17p} \left\{ \int_{-4p}^{12p} - \int_{10p}^{24p} \right\} e^{-\beta^2-\gamma^2-\varepsilon^2} \, d\beta \, d\gamma \, d\varepsilon \quad (18)$$

Here $\Delta T$ is the maximum temperature differential or maximum departure from the original 50 F and $\Delta' T$ is the departure after 5 months of recovery. The quantity $p \equiv \frac{1}{2\sqrt{\alpha t}} = 0.0494$. This equation gives on solution (which is not as difficult as it looks), $\Delta' T/\Delta T = 0.14$. This means that the final departure from the original 50 F is only 14 percent of the maximum departure of say 30 deg, or a recovery of 86 percent. Other points in the block would, in general, show a better recovery, which might average 90 percent or better for the block as a whole. For a block 20 × 75 × 14 ft the central point (7 ft deep) would show a 93 percent recovery. As a matter of fact, recent measurements[11] in such a block indicate this relatively complete recovery.

If the 400 ft of 3 in. pipe had been installed in 20 ft lengths in a block 20 × 75 × 24 ft deep, the recovery would not have been quite so satisfactory. For a central point 16 ft below the surface it might have been 82 percent. For a continuous (*i.e.*, infinite) slab 24 ft thick the recovery for such a point would be about 65 percent.

The matter of summer temperature recovery has an important bearing on the optimum pipe length for a grid of this sort. Since the surface is the most important factor in the recovery, a block of area larger than, say, 60 × 60 ft should not go much deeper than 24 ft. Long narrow blocks would show better recovery than square ones, *i.e.*, a block 30 × 120 ft would be

better than one 60 × 60 ft. If any one horizontal dimension is longer than about 60 ft it is immaterial how long it is; *i.e.*, blocks of 30 × 70 and 30 × 500 ft would show about equal recovery.

In this discussion there has been assumed a sharp initial temperature discontinuity at the edges of the block at the beginning of the 5 month recovery period. This, of course, would be far from the real case. The actual recovery, taking this into account, would be a little less than that calculated, but the comparisons would still hold. It is also to be noted that summer ground surface temperatures would generally run higher than the 50 F assumed here, making for more complete recovery.

### Effect of Ice Formation

The theory here is somewhat involved and will be reproduced only in bare outline. Following the general reasoning of the Neumann ice formation treatment[3] (p. 191) results in the equation

$$k_1\left(\frac{\partial T_1}{\partial r}\right)_{r=R} - k_2\left(\frac{\partial T_2}{\partial r}\right)_{r=R} = L\frac{dR}{dt} \quad \text{(19)}$$

which expresses the fact that at the surface of the cylinder of frozen soil of radius $R$ about the pipe, the difference between the rates of heat flow from this cylindrical boundary towards the center and into this region from the surrounding soil, is the rate of release of latent heat. $L$ is the heat of fusion per unit volume of the soil.

Combining this reasoning with that of the line source Equation 9, it can be shown that

$$R = 2\sqrt{bt} \quad \text{(20)}$$

where $b$ is a constant. Also that

$$\frac{Q'}{2\pi}e^{-b/\alpha_1} - k_2\frac{T_0 - T_f}{I(b/\alpha_2)}e^{-b/\alpha_2} = 2Lb \quad \text{(21)}$$

*and*

$$T_1 = T_f - \frac{Q'}{2\pi k_1}I\left(\sqrt{b/\alpha_1}\right)\frac{I\left(\frac{r}{2\sqrt{\alpha_1 t}}\right)}{I\left(\sqrt{\frac{b}{\alpha_1}}\right)} \quad \text{(22)}$$

$$-1\Bigg\} 0 < r \leq R$$

where $k_1$, $\alpha_1$ apply to frozen and $k_2$, $\alpha_2$ to unfrozen soil. $T_0$ is the initial soil temperature, taken as 50 F, $T_1$ the temperature at any radius $r$ inside the frozen cylinder, and $T_f$ the freezing temperature. $I$ is the line source integral in Equation 9.

In illustrating the use of these equations it is assumed that a cylinder of 1 ft radius (*i.e.*, $R = 1$) of frozen soil is formed about the pipe in 6 months (4383 hr) of operation in soil A, with a heat of fusion of 3672 Btu per cu ft (*i.e.*, about 25 percent moisture). Equation 20 then gives $b = 5.70 \times 10^{-5}$. Substituting for $b$ in Equation 21 and assuming that $\alpha_1 = \alpha_2 = 0.0261$ and $k_1 = k_2 = 1.2$, $Q' = 51.4$ Btu per (hr) (linear ft) under these conditions. Without freezing, the use of the simple line source equation shows that to produce in soil A, initially at 50 F, a temperature of 32 F at $r = 1$ ft in 4383 hr requires that $Q'$ be 48.8 Btu per (hr) (linear ft).

There is a simple way of checking this result. Neglecting the relatively small volume of the pipe, the volume of the frozen soil per foot of pipe for $R = 1$ is 3.14 cu ft, giving a total heat release for absorption by the pipe of 11,540 Btu. If released at a uniform rate over 6 months this would give 2.6 Btu per (hr) (linear ft) as the contribution due to freezing, which is just the difference between the two results calculated above.

Perhaps the greatest interest centers about calculations of the pipe surface temperature with and without freezing considerations. Using Equation 22 with a 2 in. pipe ($r = 0.0833$ ft), and with $Q' = 51.4$, $T_f = 32$ F, and $b$ as calculated above, will give $T = 15.1$ F. Neglecting freezing considerations and using the line source Equation 9 we have $\Delta T = 35.9$ below the initial 50 F, giving a pipe temperature of 14.1 F.

An independent check on this temperature of 15.1 F is obtained by remembering that of the 51.4 absorption rate assumed here only 48.8 comes from the soil, the remainder being furnished by the heat of fusion. It would then be expected that if $Q' = 48.8$ is used in Equation 9, a temperature not far different from 15.1 F should be obtained. As a matter of fact, this procedure gives 15.8 F.

It may be concluded, then, that freezing considerations make relatively little difference in such pipe temperature calculations. As will be shown later it is probable that the moisture migration towards the cold pipe is a larger factor than the ice formation. It is also probable that the frozen soil has a slightly higher conductivity than the unfrozen and that this should enter into the calculations. This is in agreement with the conclusions of Coogan[12].

### Effect of Moisture Migration

As already mentioned, it is well known that there is a diffusion of moisture from warmer to cooler regions in the soil, perhaps due to vapor pressure differences. This increases the moisture content near a heat-absorbing pipe, with some increase, in general, in thermal conductivity. The diffusivity would not be expected to change as much since additional moisture would increase the specific heat as well as the conductivity. A rough calculation of the effect of such moisture increase on pipe temperatures will be attempted.

The expression for the temperature gradient near a line source or a small pipe is[3] (p. 147),

$$\frac{\partial T}{\partial r} = -\frac{Q'}{2\pi k r}e^{-r^2/4\alpha t} \quad \text{(23)}$$

If this gradient is plotted as a function of $r$ and integrated to obtain the area, the result is an expression which reduces at once to the line source integral of Equation 9. In other words the area under the curve gives the temperature differential. Accordingly, if it is assumed that the conductivity only is changed by the moisture increase and that the diffusivity is relatively constant (in any case it is a somewhat secondary factor), the new gradient may also be plotted by reducing the original gradient by

the ratio of the old and new conductivities. The area under the new curve gives the new temperature differential for a pipe absorbing heat at the some constant rate $Q'$.

Fig. 9 illustrates this. The solid line is a plot of the gradient at the end of six months for a 2 in. pipe in soil A where $Q' = 1$. The area under this curve gives $\Delta T = 0.70$ F at the surface of the pipe, which is just the value computed from Equation 9. If it is assumed that moisture migration doubles the conductivity at the pipe, increases it by 50 percent at a distance of 1 ft and is of negligible effect beyond 5 ft, the dotted curve is obtained and the area under it indicates a $\Delta T$ at the pipe of 0.54 F.

When considering the influence of one pipe on another as in neighboring loops, the effect of moisture migration will be secondary. The time required to reach the assumed moisture densities is also a factor to be considered, although it is believed that it will not greatly alter the final temperatures.

### Effect of Underground Water Movement

It is probable that for a horizontal pipe buried 6 ft or so underground and with a layer of frozen soil above, as in winter operation, underground water movement rarely comes into account. For vertical pipes and greater depths, however, there may be a slow drift of water which may vary from negligibly small values to several feet per day. Because of low velocities and small interstices between the soil grains this flow is non-turbulent.[13]

If measurements by the Slichter[14] or other method indicate such water movement, it is of interest to know about what effect this might be expected to have on the temperature of a pipe exchanging heat at a given rate. Anything like an exact calculation would be very difficult, but some idea of the order of magnitude for the very small velocities most frequently encountered may be reached in two different ways.

The first is by the use of a treatment* (p. 224, Equation 3) based on relative motion between the heat source and the medium, a method which would probably give too large values for the effect. Graphical evaluation of the equation for a flow velocity of 0.01 ft per hr in soil A indicates that, after a few months of operation, $\Delta T$ for a 2 in. pipe would be 20 percent less than for the same pipe with no water movement. Calculations for higher values of the velocity are much less certain but they indicate that for 0.1 ft per hr the reduction might be by a factor of 5.

In the other method a 2 in. pipe is assumed to be extracting heat from the soil at a rate $Q'$ of 40 Btu per (hr) (linear ft) for two months, giving a certain easily-calculated temperature distribution in the soil about the pipe (soil A, with the assumption that 30 percent of its weight is water). Now let the water flow slowly through this region, adding as it does so, a certain amount of heat to each zone about the pipe. This will give a larger $Q'$ for a given $\Delta T$ than would otherwise be the case. Calculations indicate for a flow velocity of 0.01 ft per hr an increase of 19 percent in $Q'$ and for 0.1 ft per hr, 79 percent. While the discrepancy between the results obtained by the two methods of calculation is large for the higher velocity, the results for the other are in good agreement. It may be concluded that water movement gives an effect of the order of 20 percent for a velocity of 0.01 ft per hr and is relatively negligible for much smaller velocities.

### Soil Conductivity Measurements

It is obviously desirable to be able to determine the thermal conductivity and diffusivity of the soil in a given location. To be of value this should be done with an absolute minimum of soil disturbance because of the effect of any digging up and repacking in lowering the conductivity.

Perhaps the best method is that mentioned in (*f*) of the previous section on pipe grids whereby thermocouples give the temperature at different depths throughout at least one whole year. To meet the need for quicker action the *British Electrical and Allied Industries Research Association*[15] has developed a method using a buried copper sphere 9 in. in diameter (they have also used a cylinder), to which electrical energy is supplied until a steady state is reached. Measurement of its surface temperature then allows (by Equation 5*a*) a calculation of the soil conductivity, and simple determinations of specific heat and density then give the diffusivity. The objections to this method are the necessary soil disturbances, the time required for the attainment of the steady state (this might perhaps be shortened by the use of Equation 5), and—most important of all—the fact that the soil would be somewhat dried by the heating and accordingly might give lower than normal values of the conductivity.

To obviate some of these objections it is suggested that a cylindrical slightly tapered calorimeter be used with *guard rings* above and below, that it be kept at a *lower* temperature than the surrounding soil (using melting ice as a measure of the heat abstracted), and that the transient rather than the steady state be used, applying in the calculations the foregoing Table 1. The authors hope to give this method a trial in the near future.

### Conclusions

1. Planar exchangers and (roughly spherical) cavities are both inferior to the relatively isolated pipe, on the basis of exchanger rate per unit area.

2. On this same basis a small pipe is more efficient than larger ones.

3. In the matter of pipe grids, such forms as flat grids, star grids, and closely-wound pipe helixes are all of questionable efficiency. A hairpin loop with the two parts well apart in a trench should show good efficiency, which would be lowered, however, for two such loops in the same trench. The long pipe with many short laterals is worth consideration and the grid made up of vertical well-separated pipes has good possibilities.

4. Lack of ground temperature recovery in summer need not be a concern unless a large block of ground deeper than some 20 ft has been cooled by winter operation.

5. Freezing of moist soil about the exchanger pipe will retard the cooling of the pipe somewhat, but the effect is not

large, being of the order of approximately 10 percent, which accordingly will increase only slightly the efficiency of winter operation.

6. The effect of moisture migration to the cold pipe will increase the soil conductivity and accordingly lessen the temperature gradient near the pipe and therefore lessen the pipe temperature differential. This would tend to increase heat pump efficiency.

7. Underground water movement becomes of notable importance only when the velocity exceeds 0.01 ft per hr.

### Acknowledgment

The authors wish to thank the several heat pump engineers who have criticized this paper in manuscript form; these include M. S. Oldacre and H. A. Adler of the Utilities Research Commission, Chicago; O. O. Wagley of the Wisconsin Electric Power Co., Milwaukee; and D. M. Vestal, Jr., of the Texas Agricultural and Mechanical College, Reverse Cycle Heating Project. We also wish to acknowledge our indebtedness to Prof. K. J. Arnold and the Computing Service of the University of Wisconsin for the considerable amount of work in evaluating Tables 1 and 2.

### Symbols

$\alpha$ = thermal diffusivity = $k/\rho c$, square feet per hour.

$\beta, \gamma, \varepsilon$ = variables of integration.

$\rho$ = density, pounds per cubic foot.

$c$ = specific heat, Btu per (pound) (Fahrenheit degree).

$e$ = Naperian base of logarithms.

$I(x)$ = line source integral. (See Equation 9).

$k$ = thermal conductivity, Btu per (hour) (square foot) (Fahrenheit degree per foot).

$L$ = latent heat of freezing of soil, Btu per cubic foot.

$L_p$ = length of (short) pipe, feet.

$q$ = rate of heat flow, transfer, or absorption, Btu per hour.

$Q$ = rate of heat transfer per hour per linear foot of pipe, Btu per (hour) (linear foot).

$r$ = distance from center line of pipe or cavity, feet.

$R$ = radius of pipe or cavity, feet. In the discussion of ice formation, $R$ is the radius of the cylinder of frozen soil around the pipe.

$t$ = time since start of operations, hours.

$T$ = temperature at any point, Fahrenheit.

$\Delta T$ = *temperature differential* or difference between the temperature of *surface* of exchanger (or other point under consideration) and *initial* soil temperature, Fahrenheit degrees.

$w$ = rate of heat flow or transfer, per unit area, Btu per (hour) (square foot).

$J_0$, $J_1$, $Y_0$, and $Y_1$ of Equations 8 and 11 are Bessel functions.

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## *REMA* AND *RSES* SPONSOR EDUCATIONAL CONFERENCES

A series of four educational conferences sponsored by the *Refrigeration Equipment Manufacturers Association* and the *Refrigeration Service Engineers Society* have been announced as follows:

*May 26-27-28, 1950*
1950 Midwest Educational Exhibit and Conference, St. Louis, Mo.

*November 17-18-19, 1950*
1950 West Coast Educational Exhibit and Conference, Long Beach, Calif.

*January 26-27-28, 1951*
1951 Southwestern Educational Exhibit and Conference, Dallas, Tex.

*April 6-7-8, 1951*
1951 Eastern Educational Exhibit and Conference, Buffalo, N. Y.

Educational *briefs* in the form of illustrated talks, lectures, and motion pictures are also being provided by *REMA* with the *RSES* providing the program of educational talks, panel forums, and banquets.

## VERNON ADDRESSES ASHVE AND *ASME* GROUPS

J. R. Vernon, sales promotion manager of Johnson Service Co., Milwaukee, Wis., recently completed a speaking tour of southern and western states where he addressed groups of college engineering students at Tulane University, Louisiana State University, Louisiana Polytechnic Institute, Colorado A. & M. College, University of Colorado, University of Utah and Northwestern University. He also spoke before local chapters of the Society and sections of *ASME* in New Orleans, Shreveport, Memphis, Denver and Salt Lake City.

To student groups, he presented a survey of the field of sales engineering as a career for technical men, pointing out that more man-hours of engineering skill are required to apply properly a piece of technical equipment than are expended in its development, design and production. Before engineering groups, he discussed the temperature control field.

Mr. Vernon has served as president of both the Illinois and Wisconsin chapters of ASHVE and is also active in the *Engineers' Society of Milwaukee*, as well as *The American Society for Engineering Education*.

# Electric Analogger Studies on Panels with Imbedded Tubes†

By Carl F. Kayan*, New York, N. Y.

This paper is the result of research sponsored by THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS in cooperation with Columbia University

**SUMMARY—Studies have been undertaken for the prediction, by means of the *Electric Analogger*, of the steady-state heat transfer and internal temperature distribution for a radiant-heat panel with different tube spacings, under the following conditions: horizontal concrete slab containing ¾ in. heated imbedded tubes, bottom cover of 5 in. and top cover of (*a*) 3½ and (*b*) ¾ in., and constant top and bottom air-side conductances. The effect of *idle* tubes in panels containing *active* tubes has been explored, as representative of circumstances in which actual test panels have been experimentally investigated for heat flow and temperature distribution, with some tubes active and some inactive.**

RADIANT heating, by means of heated imbedded tubes in concrete building slabs having top and bottom exposed surfaces, involves an upward and a downward heat flow to the realm of lower ambient space temperature. When heating tubes are thus imbedded within a slab structure, they set up complex heat-flow paths for which prediction of the slab temperatures and the resultant heat transfer is difficult.

With the flow of a heating medium through the imbedded tubes, the temperature of the slab surfaces is increased above that of the ambient space. Thus the operating temperature-difference effect for the surfaces is created. With asymmetrical tube location, and in addition, with asymmetrical thermal-resistance conditions above and below the slab, the upper and the lower surfaces constitute, to differing extent, the effective heat transfer areas for the slab.

Particularly under these circumstances, the calculation of the heat-flow distribution between the two surfaces is troublesome. The present analysis is predicated on the inherent two-way heat-flow effect, and has been carried out for two slab structures with various active tube spacings, by means of the *Electric Analogger*.

This investigation, by electrical analogy method, has been undertaken as part of the program of the ASHVE Technical Advisory Committee on Panel Heating and Cooling, *Group A*.

In addition to the objective of determining heat flow and temperature distribution in this study, one particular aspect has been the determination of the comparative effect of *idle* tubes in test panels such as tested by the ASHVE Research Laboratory where tubes were cast into the slab on 4 in. centers, and tests were made with different combinations of active and idle tubes. The presence of the idle tubes posed a question as to their relative influence on the overall results.

Fig. 1 shows the structural arrangements investigated in the present program. Section (*a*) shows a monolithic concrete panel with ¾ in. tubes on 4 in. centers and bottom cover of 5 in. The top cover is 3½ in. Section (*b*) shows a panel with ¾ in. top cover.

For all of the investigations in this study, the conductivity of the concrete has been taken at $k = 9.00$ Btu per (sq ft) (hr) (F deg per in.), and the values of the surface conductances have been assumed as constant at $h = 1.11$ Btu per (sq ft) (hr) (F deg) for the top surface, and $h = 0.53$ for the bottom surface. Studies were made with active tube spacings of 4, 8, 12 and 16 in., and results are reported in terms of 70 F ambient air with tube temperatures of 120 and 170 F.

## Experimental Model Relationships

In accordance with previously described procedures which need not be detailed here[1-3], and using electrically conductive flat sheet, a full-scale 48-in. section *Analogger* model was constructed to represent the two-dimensional heat flow conditions of the panels. This is shown in Fig. 2, with electrical connections. Two-way slab heat flow was simulated by two-way electrical flow. Electrodes, to represent the ambient-air conditions above and below, are shown in the diagram, along with the electrodes to represent the imbedded tubes. In the test program, the active-tube electrodes were connected to the source of electrical current, with the inactive *idle* tubes disconnected but left in place on the model. To determine the comparative effect, due to the presence of these idle tubes in the direct experiments of the

†Abstract of this report presented at the 56th Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Dallas, Tex., January 1950.

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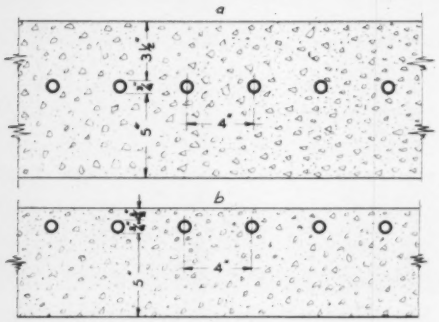



Fig. 1—Pipe location in experimental panels

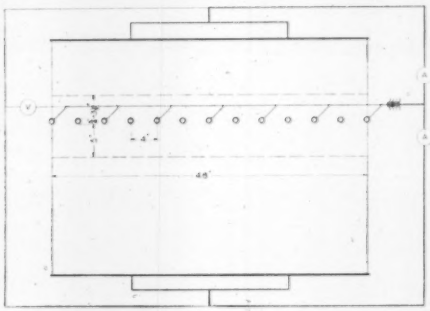


Fig. 2—Diagram of 48-inch Analogger model

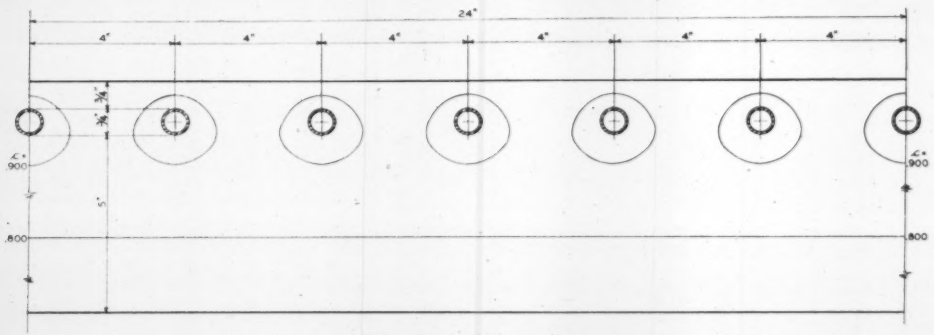
ASHVE Research Laboratory, separate tests were made in the ¾ in. top-cover series with the idle-tube electrodes physically removed from the model. The ¾ in. top-cover series was regarded as the more critical in its idle tube aspect.

The electrical analogy procedure is based on the similarity between the flow of heat in thermal circuits and the flow of current in electrical circuits, *i.e.*, Ohm's law for electrical resistance circuits has its counterpart in heat flow circuits. This is conventionally identified as the *resistance concept* of heat transfer.[1] In accordance with this principle, the characteristics of the heat flow are established, by analogy, through the study of an equivalent electrical system. Determination of the isopotential lines through the electrical study then permits establishment of the temperature distribution in accordance with the existing overall temperature difference for the given thermal structure.

In the present *Analogger* model, regions between the electrodes on the conductive sheet represent, to scale, the electrical resistance sections equivalent to the thermal resistance sections. The effect of the boundary conductance at the surfaces is introduced by off-setting the *ambient-air* electrodes a given distance from the panel section, commensurate with the thermal resistance. (Thus for example, for $h = 0.53$ and $k = 9.00$, $x_e$ will be 17 in., as explained later in text referring to Equation 6). On the sheet model, these sections for the top and bottom conditions were, in addition, slit at regular intervals, perpendicularly to the electrodes, to prevent lateral electrical flow in the *boundary* region.

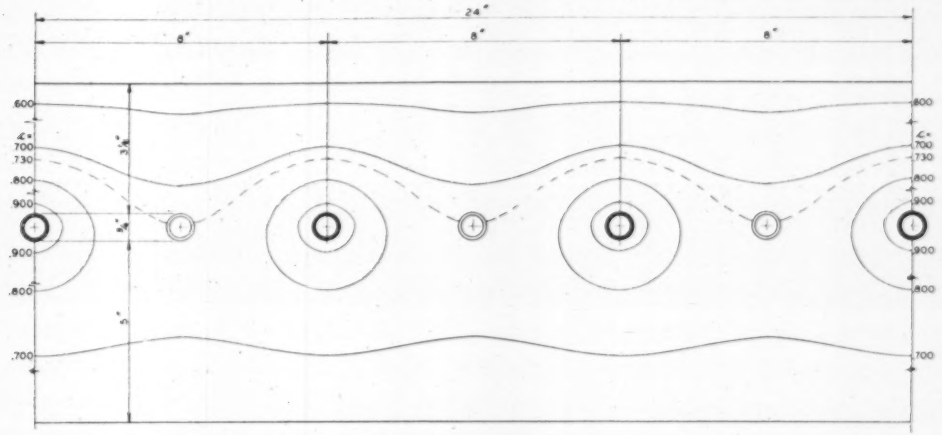
At the very outset it must be emphasized that the results of the present study are based solely on the assumed basic thermal conductivity and boundary conductances. These values, though representative, have been selected arbitrarily and are, in addition, taken as independent of temperature. The joint between the tubes and the concrete is presumed to represent negligible resistance.

[1]Exponent numerals refer to References.




(Series A, 3½ in. top cover)

Fig. 3—Isopotential patterns for 4-inch tube spacing




(Series A, 3½ in. top cover)

**Fig. 4—Isopotential patterns for 8-inch tube spacing**

Electrical measurements on the model yield the potential difference ratio $c$, defined:

$$c = \Delta e_p / \Delta e \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

*where*

$\Delta e_p$ = potential difference between the ambient-air electrodes and a given point p within the panel section;

$\Delta e$ = electrical potential difference between the active tube electrodes (equi-potential) and the air-electrodes (equi-potential).

The value of $c$ is most conveniently established by means of the slide-wire bridge circuit.[2]

Equivalent temperatures throughout the slab may be established on the basis of the overall temperature conditions:

$$t_p = t_a + c\Delta t \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

*where*

$t_p$ = Fahrenheit temperature at a given point p

$t_a$ = Fahrenheit temperature of the ambient air

$\Delta t$ = overall temperature difference between the imbedded tubes and the air, degrees.

The following thermal resistance relationships are of interest:

$$R_s = 1/h_s \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

*where*

$R_s$ = equivalent thermal resistance at the air boundary, Fahrenheit degrees, Btu per (square foot) (hour)

$h_s$ = air boundary surface conductance, Btu per (square foot) (hour) (Fahrenheit degree).

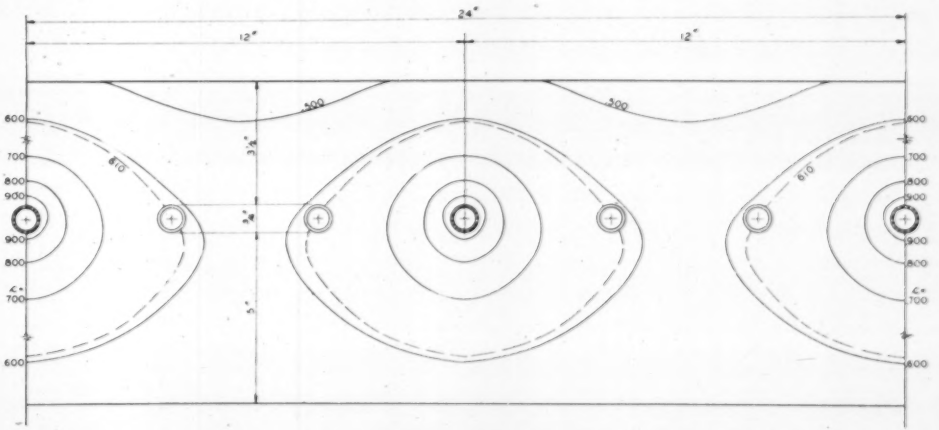
The resistance $R_w$ of wall or slab material of uniform composition:

$$R_w = x_w / k \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

*where*

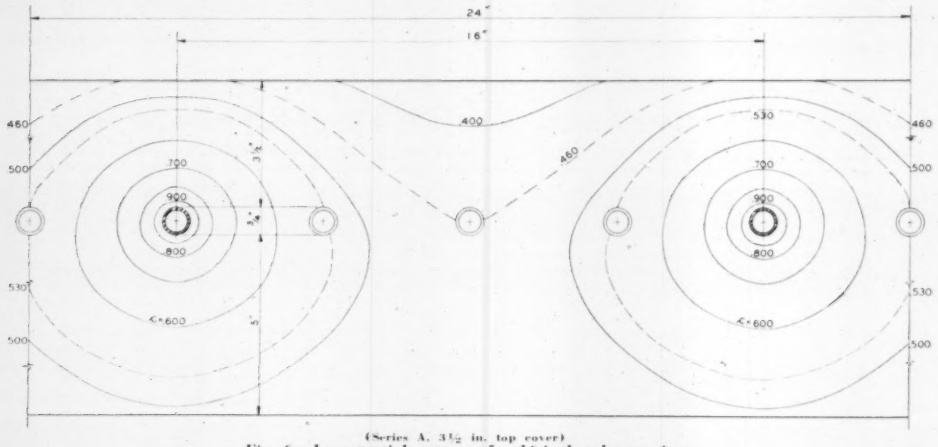
$x_w$ = thickness of wall or slab, inches

$k$ = thermal conductivity of wall or slab material, in Btu per (square foot) (hour) (Fahrenheit degrees per inch).



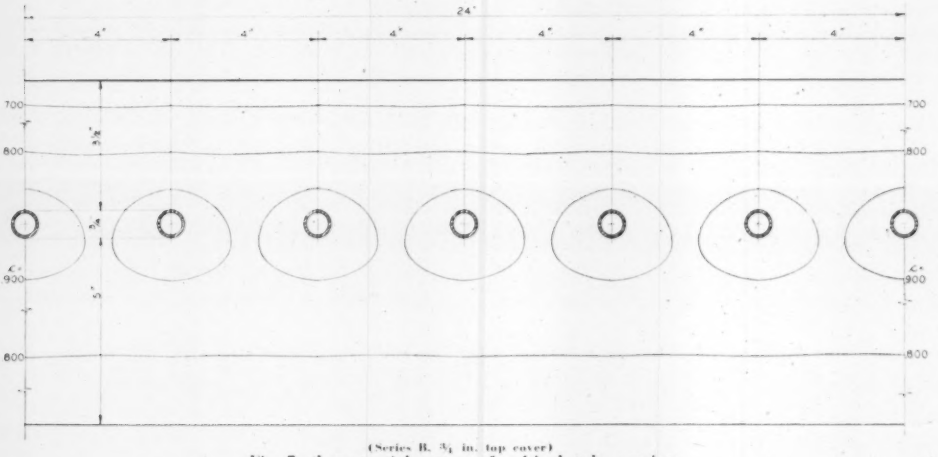

(Series A, 3½ in. top cover)

**Fig. 5—Isopotential patterns for 12-inch tube spacing**



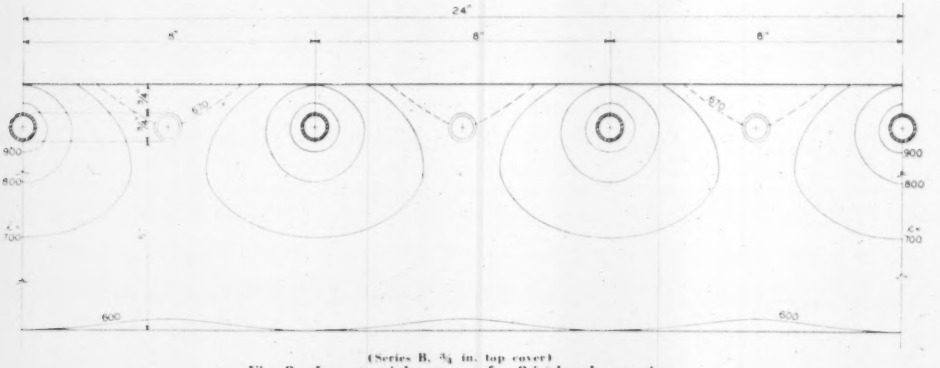

(Series A, 3½ in. top cover)

**Fig. 6—Isopotential patterns for 16-inch tube spacing**



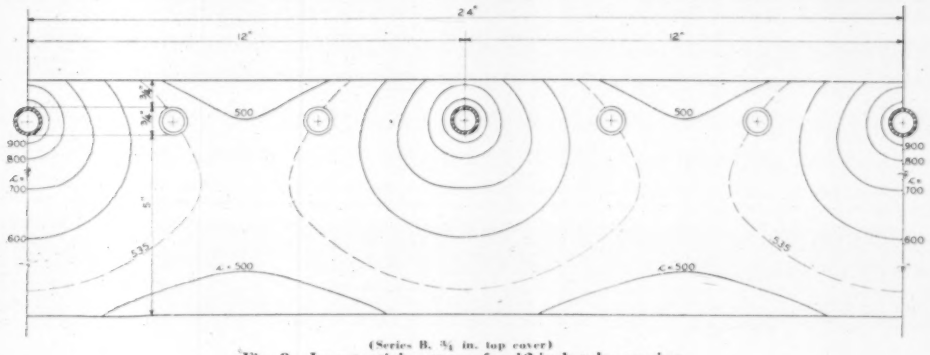

(Series B, ¾ in. top cover)

**Fig. 7—Isopotential patterns for 4-inch tube spacing**




(Series B, ¾ in. top cover)

**Fig. 8—Isopotential patterns for 8-inch tube spacing**




(Series B, 3/4 in. top cover)

**Fig. 9—Isopotential patterns for 12-inch tube spacing**

As previously indicated in Equation 3, for a given value of $h_a$ there is a corresponding value of resistance $R_a$. Thus, for a given conductivity of slab material, there is some equivalent thickness $x_e$ of slab material that would give the same resistance $R_a$ to heat transfer as the air boundary:

$$R_a = 1/h_a = R_e = x_e/k \quad \ldots\ldots (5)$$

Thus,

$$x_e = k/h_a \quad \ldots\ldots (6)$$

This value of $x_e$ is employed in the construction of the Analogger model, and represents the distance on the full-scale model by which the air electrodes are off-set from the panel section. Thus, distances on the model produce electrical-resistance values having the same relationship to one another as the thermal resistances, *i.e.* linear distances on the conductive sheet are commensurate with thermal resistances.

Electrical measurements also make possible the determination of an overall resistance ratio $f$:

$$f = r_t/r_w \quad \ldots\ldots (7)$$

*where*

$r_t$ = measured overall electrical resistance on the model between an air-electrode and the tube electrodes, based on current and voltage values, under the different test conditions;

$r_w$ = electrical resistance of the model reference strip representing the plain slab, *i.e.*, the resistance of sheet material as measured between two parallel electrodes spaced apart by a distance equal to the slab thickness, and extending the full width of the model (48 in. in this case).

This dimensionless electrical ratio $f$ has its counterpart in an equivalent thermal ratio $F_T$, and represents the transition bridge between the measured electrical flow for the model and the predicted heat flow for the slabs. Thus

$$f = F_T = R_t/R_w \quad \ldots\ldots (8)$$

*where*

$R_t$ = thermal resistance (per square foot, average, for the 48 in. slab section) of the slab-tube assembly under the different conditions;

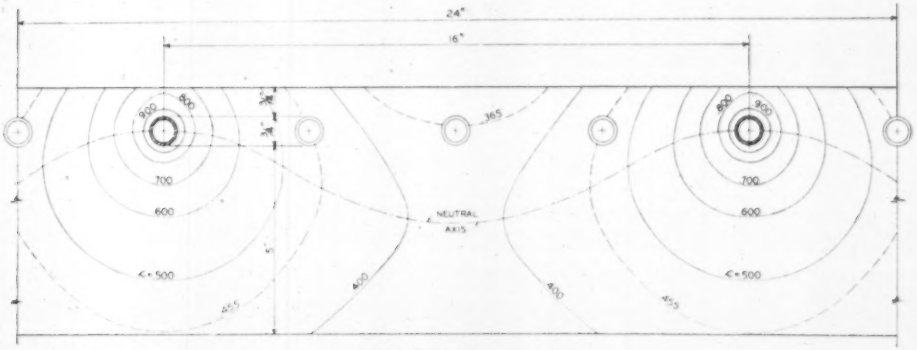
$R_w$ = thermal resistance (per square foot) of the reference thickness for the slab, *i.e.* $= x_w/k$.

Thus

$$R_t = R_w F_T \quad \ldots\ldots (9)$$

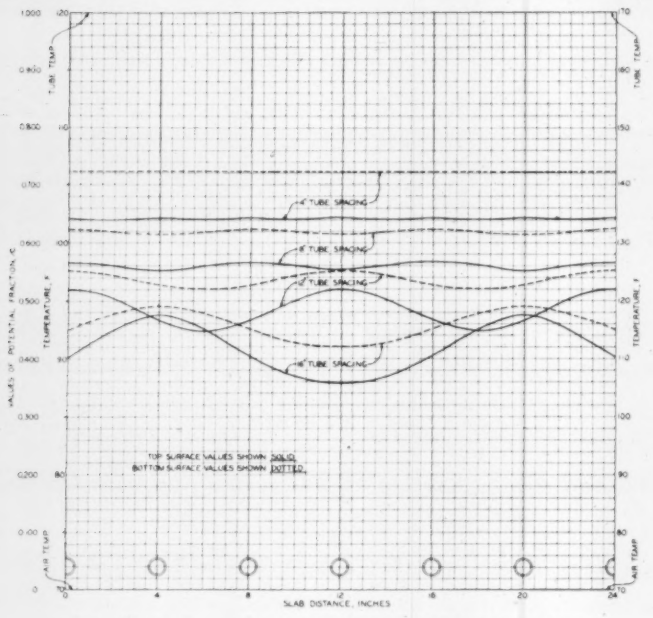
It should further be noted for heat-flow computation:

$$H_{aver} = \Delta t/R_t \quad \ldots\ldots (10)$$



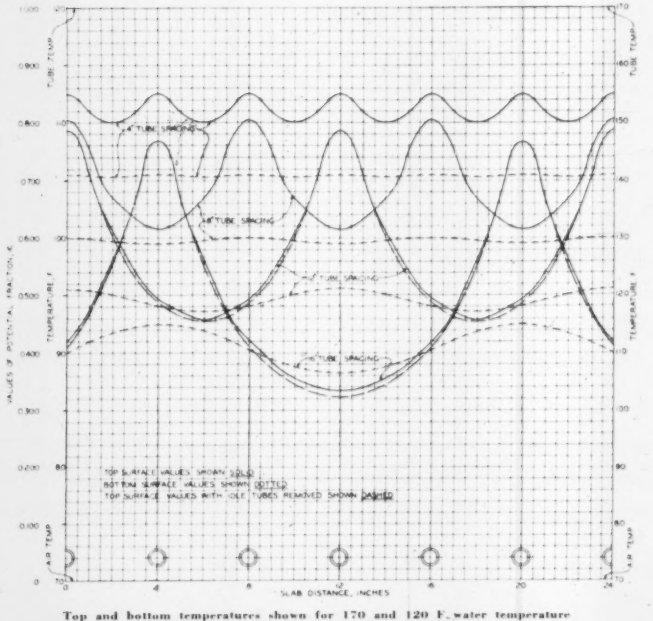

(Series B, 3/4 in. top cover)

**Fig. 10—Isopotential patterns for 16-inch tube spacing**




Top and bottom temperatures shown for 170 and 120 F water temperature

**Fig. 11—Panel surface temperature variation for 3½-inch cover**




Top and bottom temperatures shown for 170 and 120 F water temperature

**Fig. 12—Panel surface temperature variation for ¾-inch cover**

*where*

$H_{aver}$ = average heat flux for the slab surface, Btu per (square foot) (hour);

$\Delta t$ = overall temperature difference between air and tubes.

For each surface of area $A$, in square feet, the gross heat flow $q$, in Btu per hour is given by

$$q = AH_{aver} \quad \ldots\ldots\ldots\ldots\ldots\ldots (11)$$

## Test Program

As noted earlier, this investigation comprised studies on two concrete slab constructions shown in Fig. 1, each with ¾ in. tubes on 4 in. centers and 5 in. bottom cover, as follows: Series A, top cover of 3½ in; Series B, top cover of ¾ in. The extent of the slab studied was 48 in. and the *Analogger* model was made to scale with a width of 48 in.

For both series, electrical studies for isopotential patterns and resistance values were made with different tube combinations. One test covered conditions with all the tubes active, *i.e.*, active tubes on 4 in. centers. Another test covered active tubes on 8 in. centers, with the single intermediate tubes idle remaining in place on the model but *unheated*, *i.e.* disconnected. In another test, active tubes on 12 in. centers were used with two intermediate idle tubes, and in another test, active tubes on 16 in. centers, with three intermediate idle tubes were used. Resistance studies were made in all these tests, and also, in addition, on 24 in. active tube spacing.

Although the regularity of the temperature patterns for the 3½ in. top-cover series indicated that the idle tubes exerted no particular influence, even with a low conductivity value ($k$ = 9.00) for concrete, the idle-tube aspect was further probed under the more severe conditions of the thin top cover of ¾ in. For this case, the idle tube *electrodes* were actually removed from the set-up, and both temperature-pattern and resistance studies carried on, for comparison with the conditions in which the idle tubes remained in place but were electrically disconnected.

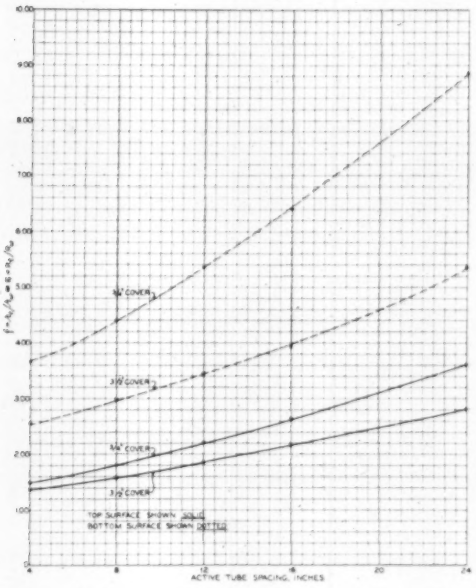



**Fig. 13—Values of $f = F_T$ in relation to active tube spacing**

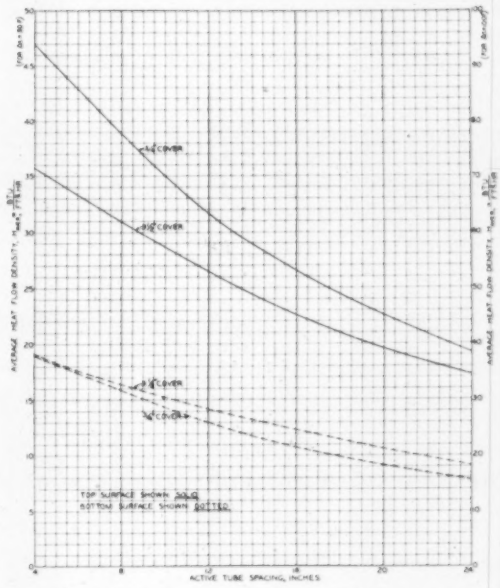



**Fig. 14—Average heat flow per square foot from top and bottom surface for 120 and 170 F water temperature**

## Temperature Results

For all of the studies, the air temperature was taken at 70 F, and the results evaluated in terms of two tube temperatures, namely, 120 F and 170 F. As noted previously, temperatures may be derived from the values for the potential difference ratio $c$. Table 1 permits ready

**Table 1—Slab Temperature Corresponding to Potential Difference Ratio c**

| Potential Difference Ratio c | Tube Temperature 120 F | 170 F |
|---|---|---|
| 1.000 | 120 | 170 |
| 0.900 | 115 | 160 |
| 0.800 | 110 | 150 |
| 0.700 | 105 | 140 |
| 0.600 | 100 | 130 |
| 0.500 | 95 | 120 |
| 0.400 | 90 | 110 |
| 0.300 | 85 | 100 |

translation of values of $c$ (in isopotential patterns) into equivalent temperatures for the slab under the two tube-temperature conditions.

Figs. 3, 4, 5 and 6 show the isopotential patterns for Series A (3½ in. top cover), with 4 in., 8 in., 12 in. and 16 in. active tube spacings respectively, and with the intervening tubes idle as previously indicated. The comparative effect of the spacing on the location of the different isotherms may be seen directly. The regularity of the equivalent temperature patterns, in spite of the idle tubes, is also to be noted, indicating little, if any, effect from the idle tubes. The isotherms going through the idle tubes are also shown.

Figs. 7, 8, 9 and 10 show the patterns for Series B, with the ¾ in. top cover, for the 4, 8, 12, and 16 in. active tube spacings respectively, and corresponding to the Series A patterns of Figs. 3, 4, 5, and 6. Here, also, the paths of the idle-tube isotherms are indicated throughout the panel. A neutral axis typically illustrating the separation of the slab into zones of upward and downward heat flow components has been added to Fig. 10.

Of particular interest are the temperature variations along the top and bottom surfaces. These are shown for Series A, 3½ in. cover, in Fig. 11, and for Series B, ¾ in. cover, in Fig. 12. For both, the effect of the active tube spacing is markedly evident. The spread of temperatures, from the maximum at the active-tube location to the minimum at the midpoint between the active tubes, is to be noted. The variation for the bottom surface is considerably less than for the top surface, by virtue of the greater effective thermal resistance on the lower section. The comparison between the 3½ and the ¾ in. top covers is likewise noteworthy, highlighting the controlling influence of a thin cover. For Figs. 11 and 12, two temperature scales are shown: the left is for a tube temperature of 120 F, and the right, for a tube temperature of 170 F.

The effect of idle tubes in the slab is directly brought out in Fig. 12 for the ¾ in. cover. As noted previously, separate pattern studies were made with the idle-tube electrodes physically removed from the model. The effect is not very great,

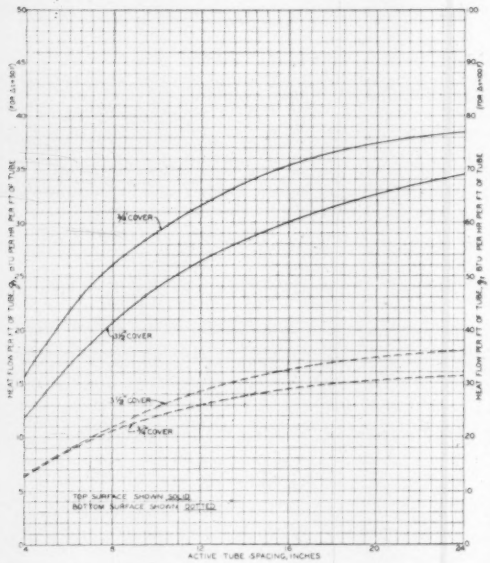



**Fig. 15—Heat flow per foot of tube length for 120 and 170 F water temperature**

as can be seen from the comparison of top-surface temperature lines for the 12- and 16-in. spacings. However, the irregularity of the temperature lines with idle tubes in place is to be noted, particularly the *flat* sections where the intermediate idle tubes have distorted the normal pattern. This effect was not noticeable with the thick 3½ in. cover. With the removal of the idle tubes, the temperature lines became more regular, and were slightly displaced from their previous position. The idle-tube influence proved relatively negligible on the overall-resistance values: differences could scarcely be noticed.

### Heat Transfer Evaluations

Through the determination of electrical resistance values from the model studies, the dimensionless resistance ratio $f$ of Equation 7 was established. For Series A, the value of $r_w$ was taken in terms of the slab thickness of 9.25 in., and for Series B, in terms of the corresponding slab thickness of 6.50 in. The overall resistance for the different tube combinations was determined separately for both the top-cover and bottom-cover portions of the slab, with the idle tubes in place on the model. As previously indicated, the effect of removing the idle tubes from the model proved scarcely noticeable.

Fig. 13 shows the value of $f = F_T$ plotted against active-tube spacing, for both top and bottom portions of the two slabs under study.

In Fig. 14, through the use of ratio $F_T$ and the corresponding value for $R_t = R_w F_T$ (Equation 9), the value of $H_{w,cr}$ in Btu per (sq ft) (hour) has been plotted against tube spacing (see Equation 10). Two scales are shown, the left one for tube temperature of 120 F, and the right one for tube temperature of 170 F. To correspond with the electrical evaluation, $R_w$ has been based on the actual slab thickness, *i.e.* 9.25 in. for Series A, and 6.50 in. for Series B.

From the results shown in Fig. 14, the heat transfer performance for the two slabs may be compared directly. It should be remembered that the two slabs are alike in all respects, thermal and structural, except for the thickness of the top cover, *i.e.* 3½ in. *vs.* ¾ in. The increased top-surface values of $H_{w,cr}$ for the ¾ in. cover over those for 3½ in. cover are readily to be noted and easily accounted for. Particular attention is directed, however, to the performance of the bottom surfaces, for which the two slab conditions were presumably identical. As a result, however, of the decreased top cover of ¾ in. instead of 3½ in., the heat flux through the bottom was directly influenced, as may be seen from the decreased values for the ¾ in. cover curve. It may thus be recognized that the differing distortion of the isotherms through the bottom cover is directly associated with the thickness of the top cover. This is likewise evident from the study of the slab temperature patterns.

Fig. 15 shows the results of Fig. 14 converted to heat flow values per foot of tube length, typical of necessary design data for the output of panel surface.

### Acknowledgment

The author wishes to acknowledge, with appreciation, the support of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS in making this cooperative project possible.

Acknowledgment is also gratefully made to C. M. Humphreys, senior engineer, ASHVE Research Laboratory, Cleveland, for helpful suggestions, and to Prof. J. Arthur Balmford, Electrical Engineering Department, Columbia University, New York, for his cooperation on electrical details.

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2. Effect of Floor Slab on Building Structure Temperatures and Heat Flow, by C. F. Kayan (ASHVE TRANSACTIONS, Vol. 53, 1947, p. 377).

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# Measurement of Ventilation Using Tracer Gas Technique

by J. B. Dick*, Garston, Watford, Herts., England

**SUMMARY — The ventilation measurements now being made at the Building Research Station, England, are outlined. The use of a tracer gas technique to measure the air change rates in rooms is described, and it is shown how this technique has been extended to the estimation of the rate at which heat is lost by ventilation processes from heated rooms and houses. A description is given of the installation in the experimental houses which enables these measurements to be made when the houses are occupied without interfering with the normal life of the tenants.**

THE VENTILATION measurements taken in residences at the Building Research Station, England, are part of the general program of post-war research in heating and ventilation being conducted by the *Building Research Board* of the *Department of Scientific and Industrial Research*.[1]

The house heating tests are designed to give much needed data on the performance of heating systems and the value of insulation. In each of the tests made to date, there have been two distinct periods: (1) the unoccupied period in which the heating appliances were tended by laboratory staff members and the houses were heated to the required temperature levels with doors (internal and external) and windows closed and (2) the occupied period in which the tenants led their normal lives and thus controlled the temperature levels and the opening of doors and windows accordingly.

When considering the results of such tests from the point of view of both efficiency and economics, it was necessary to know the heat loss from the house by ventilation.[2,3] The natural ventilation systems were designed to suit the different heating systems in the houses and varied between houses. It was necessary, therefore, to determine air change rates in the rooms for both occupied and unoccupied periods. These requirements have been met by developing the methods for measurement of air change rate described in this paper and applying them as illustrated by examples of the measurements taken in the two periods.

The houses concerned in these trials were two story semi-detached buildings containing seven rooms with a total volume of about 7000 cu ft, and during the unoccupied period were heated to an average of about 20 F above the external temperature.

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[1]Exponent numerals refer to references.

## Air Change Measurements Using a Tracer

The air change rate of a room is usually defined as the ratio of the rate at which air enters (or leaves) the room divided by the volume of the room. The effective air change rates in different regions of a room are not necessarily the same, but it is common practice to refer to an air change rate for a room, just as a single room temperature is used to express room temperature when, in fact, there may be some variation in temperature throughout the room. In recent years, the air change rates in rooms of both apartments and houses have been measured by a number of investigators by introducing a tracer substance into the room, mixing it thoroughly with the air, and then measuring the subsequent rate of decay.[4-9] If there is complete mixing between the replacement air and the air in the room, the concentration of the tracer during the decay is given by:

$$-v\frac{dc}{dt} = xc$$

*where*

$c$ = concentration of tracer at time $t$.

$x$ = volume of air entering (or leaving) the room in unit time.

$v$ = volume of room.

The solution for the initial condition $c = c_o$ and $t = 0$ is

$$c = c_o\, e^{-\frac{x}{v}t} = c_o\, e^{-Rt} \quad \ldots\ldots (1)$$

*where*

$R$ = number of air changes in unit time.

Hence

$$\log_e c = \log_e c_o - Rt$$

Thus by plotting the logarithm of the concentration against time, the rate of air change is obtained from the slope of the line best fitting the points. Examples of decay measurements are shown in Figs. 1 and 2.

Various techniques have been used in the measurements by different investigators. Gases and vapors have been used as tracers, and physical and chemical methods of analysis have been used for estimation of the concentration. The technique adopted at the Building Research Station is one first used by Marley[6], who used a gas (usually helium or hydrogen) as the tracer; its concentration being measured by a katharometer[10,11] (or thermal conductivity meter) and recording galvanometer. This technique has been adopted mainly because of its suitability for continuous electrical recording of the concentration of the tracer, and also because a gas rather than a vapor was preferred as a tracer for general use; thus

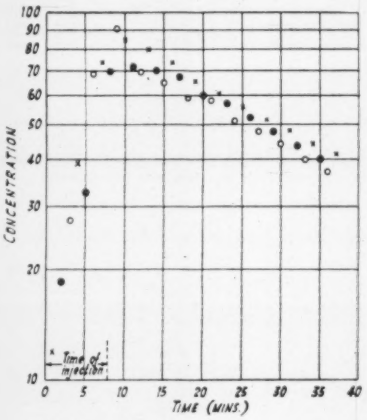



**Fig. 1—Concentrations of tracer gas measured at 3 points in a room during a distribution test**

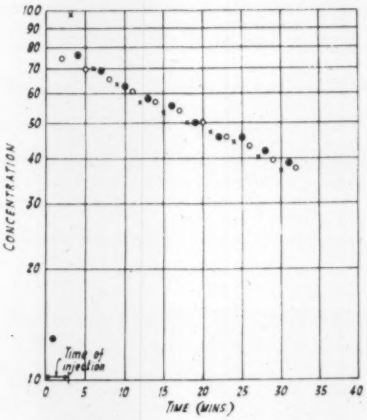


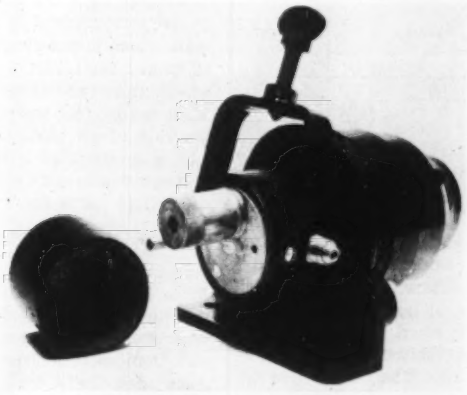

**Fig. 2—Concentrations of tracer gas measured at 3 points in a room during a distribution test**

reducing any possibility of absorption or condensation.

In a katharometer, a platinum spiral mounted centrally in a small cell in a metal block is heated by a constant electrical current. As the convection currents are small, the rate of heat loss from such a spiral is very closely proportional to the thermal conductivity of the gas surrounding it, and thus the introduction of a tracer gas, whose thermal conductivity differs from that of air, will change the rate of heat loss from the spiral and hence its temperature and resistance. This change in resistance is usually measured by making the spiral one arm of a Wheatstone bridge circuit; for small concentrations the output is proportional to the percentage of tracer gas present. The instrument is very sensitive, a 7-ohm bridge giving an open circuit output of 10 millivolts for 1 percent hydrogen in air. With the recording galvanometer used (resistance 40 ohms, sensitivity 40 microamps for full scale deflection) it is thus possible to detect the presence of 1 part hydrogen in 10,000 parts of air. Other gases suitable for use as tracers include helium and carbon dioxide which, although they only produce 0.64 and 0.13 times the output given by hydrogen for a given percentage of gas in air, have the advantage of safety. For use in occupied houses helium has therefore been adopted as a tracer in preference to the hydrogen which was used by Marley in his original experiments.

Fig. 3 shows the type of katharometer used. In this type the gas enters the sampling cell by diffusion through an absorption chamber containing a drying agent (a process which for hydrogen has a time constant of the order of 20 to 30 sec and thus does not appreciably affect the measurement of normal rates of air change). When using helium or hydrogen as the tracer, the effect of background variations of carbon dioxide content may be minimized by using soda asbestos in the absorption chamber. These instruments have a slight temperature coefficient, a change of 1 deg in the ambient temperature giving an output equivalent to that produced by about 0.01 percent hydrogen, so that in order to take full advantage of the sensitivity, it is desirable to have the katharometer in a thermostatically controlled chamber. The chamber was omitted when making mobile measurements in rooms, the katharometers being used with caps removed as shown. When concentrations were measured in samples of air withdrawn from the rooms, the katharometers were installed in a thermostatically controlled cabinet, and the samples of air were drawn through the fitted caps past the ends of the absorption chambers, the entry of gas into the cells being completed by diffusion.

In an air change measurement in an unoccupied room, sufficient hydrogen is introduced into the room to give an initial concentration of about 0.2 to 0.3 percent. A fan is operated until the air and gas are mixed, after which the fan is stopped during the measurement of the decay. The concentration of tracer gas is initially measured by several katharometers spaced throughout the room; if the variation in measured decay rate at different locations is small, then, for similar conditions of temperature etc., the subsequent measurements are made using a single katharometer placed centrally in the room. In the houses investigated in the heating tests, the variation in decay rates at different locations was small except in the space comprising entrance hall, stairs to upper floor and passage upstairs. The convection currents produced by the heating appliances and walls and windows with surface temperatures differing from that of the room air were sufficient to maintain adequate circulation within the square or rectangular rooms, but



(Shows absorption chamber through which gas diffuses into the sampling cell)
**Fig. 3—Katharometer with cap removed**

the currents were not sufficient to be effective in the hall and irregular spaces.

The technique described has been extended to meet the requirements of the present experiments, but it should be noted that other tracers and methods of measurement could well be used; for instance, a radioactive tracer gas might be suitable.

## The Components of Air Change and Consequent Heat Loss

It will be seen that the air change rates obtained yield only the rates of flow into or out of a room, and do not distinguish between exchange with the remainder of the building and exchange with the external air. The separation of air flow into these components is necessary both when determining the adequacy of ventilation in a room (the air coming from adjacent rooms may or may not be contaminated) and when estimating the heat lost by ventilation from a room or a building.

Since the rate of air flow from a room is equal to the air flow into a room, the air balance equation for a room in a house with $n$ rooms may be written

$$\sum_{r=2}^{n} x_{1\cdot r} + x_{1\cdot o} = \sum_{r=2}^{n} x_{r\cdot 1} + x_{o\cdot 1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

*where*

$x_{1\cdot r}$ = rate of air flow from room 1 to room r.

$x_{r\cdot 1}$ = rate of air flow from room r to room 1.

$x_{1\cdot o}$ = rate of air flow from room 1 to outside.

$x_{o\cdot 1}$ = rate of air flow from outside to room 1.

Equation 2 neglects the effect of change of volume with temperature but this effect is usually small compared with the inherent variance of ventilation measurements.

The rate $h$ at which heat is lost from the room by the flow of air is:

$$h = s\left[\sum_{r=2}^{n} (x_{1\cdot r}T_1 - x_{r\cdot 1}T_r) + x_{1\cdot o}T_1 - x_{o\cdot 1}T_o\right] \ldots\ldots\ldots (3)$$

*where*

$s$ = volume specific heat of air.

$T_r$ = temperature of air in room $r$.

$T_o$ = external temperature.

and the rate $h_1$ of heat loss from the room to outside alone is

$$h_1 = s[x_{1\cdot o}T_1 - x_{o\cdot 1}T_o] \quad \ldots\ldots\ldots (4)$$

Again this is an approximation as it neglects changes in humidity. It also assumes that the air leaving a room is at the mean room temperature, and thus does not make any allowance for heat gained by air as it passes up a heated flue—a heat interchange which is normally included in the overall efficiency of a heating appliance.

The rate $H$ of heat loss from the house due to exchange of air with the outside is a summation for all rooms (using equation 4):

$$H = \sum_{r=1}^{n} s\,[x_{r\cdot o}T_r - x_{o\cdot r}T_o]$$

and since

$$\sum_{r=1}^{n} x_{r\cdot o} = \sum_{r=1}^{n} x_{o\cdot r}$$

the rate of heat loss $H$ is

$$H = s\sum_{r=1}^{n} x_{r\cdot o}\,(T_r - T_o) \ldots\ldots\ldots (5)$$

an expression which does not directly involve the interaction components between rooms.

## Using a Tracer Gas to Determine the Components of Air Change and Consequent Heat Loss

1. *Ventilation of Rooms:* If, during the decay of the tracer gas in a room, leakage occurs to an adjacent room through a ventilator or cracks around a closed internal door, the rate of air flow may be determined from the concentration of tracer gas in the second room. It was found in the experimental houses that this type of air flow was generally unidirectional, that is, there was seldom reversal of flow, for instance, at the top and bottom of a door. The effect of temperature difference between rooms was obscured by the effects of wind, heated flues and differences between internal and external temperatures. With a unidirectional flow from room 1 into an adjacent room (room 2) at a volume rate of $x_{1\cdot 2}$, the equations for the concentration of tracer gas, using the nomenclature previously defined, are

$$-v_1\frac{dc_1}{dt} = (x_{1\cdot o} + x_{1\cdot 2})c_1$$

$$-v_2\frac{dc_2}{dt} = x_{1\cdot o}c_2 - x_{1\cdot 2}c_1$$

*where*

$v_1, v_2$ = volumes of rooms 1 and 2.

$c_1, c_2$ = concentrations of tracer gas in rooms 1 and 2, respectively.

At time $t$, and with the initial conditions of $c_1 = c_o$, $c_2 = c_o'$ at $t = 0$ the solutions are

$$c_1 = c_o e^{-\frac{x_{1\cdot o} + x_{1\cdot 2}}{v_1} t}$$

$$c_2 = c_o \frac{x_{1\cdot 2}}{v_2} \frac{1}{\left(\frac{x_{2\cdot o}}{v_2} - \frac{x_{1\cdot o} + x_{1\cdot 2}}{v_1}\right)} \times \left[ e^{-\frac{x_{1\cdot o} + x_{1\cdot 2}}{v_1} t} - e^{-\frac{x_{2\cdot o}}{v_2} t} \right] + c_o' e^{-\frac{x_{2\cdot o}}{v_2} t}$$

In practice, by sealing the cracks or ventilator (through which flow is occurring to room 2), while the tracer gas is mixed in room 1, the concentration in room 2 is zero when the decay starts in room 1. Assuming therefore that $c_o' = 0$, if $R_1$ and $R_2$ are the prevailing rates of air change in rooms 1 and 2 (equal to $\frac{x_{1\cdot o} + x_{1\cdot 2}}{v_1}$ and $\frac{x_{2\cdot o}}{v_2}$ respectively), the equations for the concentrations may be written:

$$c_1 = c_o e^{-R_1 t} \quad \ldots\ldots (6)$$

$$c_2 = c_o \frac{x_{1\cdot 2}}{v_2} \left(\frac{1}{R_2 - R_1}\right) \left[ e^{-R_1 t} - e^{-R_2 t} \right] \quad \ldots\ldots (7)$$

Hence when $R_1$ and $R_2$ are known, the shape of the leakage curve (*i.e.* $c_2$) may be calculated from Equation 7 and compared with the measured concentrations. By plotting the concentrations on a logarithmic scale against time, the multiplying factor $c_o \frac{x_{1\cdot 2}}{v_2}$ and hence $x_{1\cdot 2}$ may be found by superimposing the theoretical and observed curves. Alternatively, the observed maximum value for $c_2$ may be used to give the multiplying factor since the maximum occurs when

$$R_1 e^{-R_1 t} = R_2 e^{-R_2 t}$$

or

$$t = \frac{1}{R_1 - R_2} \log_e \frac{R_1}{R_2}$$

and hence, from Equation 7

$$c_{2(max)} = c_o \frac{x_{1\cdot 2}}{v_2} \frac{1}{R_2 - R_1} \times \left[ \left(\frac{R_1}{R_2}\right)^{\frac{R_1}{R_2 - R_1}} - \left(\frac{R_1}{R_2}\right)^{\frac{R_2}{R_2 - R_1}} \right] \quad \ldots\ldots (8)$$

and

$$\frac{x_{1\cdot o}}{v_2} = \frac{c_{2(max)}}{c_o} \times \frac{R_2 - R_1}{\left(\frac{R_1}{R_2}\right)^{\frac{R_1}{R_2 - R_1}} - \left(\frac{R_1}{R_2}\right)^{\frac{R_2}{R_1 - R_2}}} \quad \ldots\ldots (9)$$

In the unoccupied phase before taking an air change measurement in a room, the direction of the air flow through ventilators or cracks around the closed doors to adjacent rooms was determined, using smoke as a tracer; if leakage occurred to an adjacent room, then the subsequent concentration in that room was recorded. When the series of measurements in the rooms had been completed, the air change rates in individual rooms were correlated with the relevant variables (such as wind speed and direction, and temperature difference between internal and external air) and the prediction equations formed. Thus, when examining the leakage which had been recorded during a particular measurement, the air change rates in the two rooms were known, (one by measurement and the other from the prediction equation), so that either of the two methods indicated could have been used to determine $x_{1\cdot 2}$. The second method of comparing maxima, being simpler, was adopted for general use. Knowing the air flow between rooms and the total air change rate in the room, the components of air change could be calculated from Equation 2. Hence when determining the adequacy of ventilation, the replacement air entering a room could be divided into air entering from outside and air entering from the remainder of the house. Similarly when concerned with heat loss by air exchange, the amount of air leaving a room could be divided into the air passing directly to outside and that passing to the remainder of the house, so that the total rate of heat loss from the room could be calculated from Equation 3 and the rate of heat loss from the room to outside calculated from Equation 4.

As an example of the type of measurement previously described, the leakage concentrations observed in a room (room 2) during an air change measurement in an adjacent room (room 1) are shown in Fig. 4. In room 1 the initial concentration was 20 units and the measured rate of air change ($R_1$) was 2.0 per hour; the rate of air change in room 2 ($R_2$) was estimated from a prediction equation to be 3.6 per hour. The theoretical curve for the function $c_2/c_o \frac{x_{1\cdot 2}}{v_2}$ was calculated by substituting these values of $R_1$ and $R_2$ in Equation 7, and by plotting this function and the observed concentrations on a logarithmic scale and then superimposing as previously described, the multiplying factor $c_o \frac{x_{1\cdot 2}}{v_2}$ was estimated to be 17, and as $c_o = 20$ hence $\frac{x_{1\cdot 2}}{v_2} = 0.85$.

To obtain a good agreement between observed and calculated curves, a time delay of 4 min in the recorded concentrations had to be assumed. The calculated curve, assuming that $c_o \frac{x_{1\cdot 2}}{v_2} = 17$ and that there is a delay of 4 min, is shown as the full line in Fig. 4. It will be seen that agreement is good apart from the initial portion of the curve, indicating that the time lag is due rather to a time constant of mixing in room 2 than to the time displacement which has been assumed to secure agreement of the concentration curves. The process described for calculating the theoretical curve and superimposing it on the observed results has therefore been repeated, on the assumption that there is a time constant of 4 min for the mixing process in room 2. The estimated value of $c_o \frac{x_{1\cdot 2}}{v_2}$ was found to be 17, and as will be seen from the dotted line in Fig. 4 the theoretical curve shows good agreement with the observed concentrations. It may be shown that a time constant due to mixing and recording (a process which is rapid compared with the rates of air change in the rooms) will only affect the initial shape of the measured concentration curve, but that the subsequent shape and maximum value will be virtually unaltered apart from a displace-

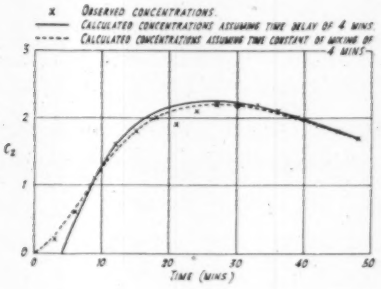

× OBSERVED CONCENTRATIONS.
CALCULATED CONCENTRATIONS ASSUMING TIME DELAY OF 4 MINS.
CALCULATED CONCENTRATIONS ASSUMING TIME CONSTANT OF MIXING OF 4 MINS.
$C_2$
TIME (MINS.)

Fig. 4—Example of leakage of tracer gas to an adjoining room

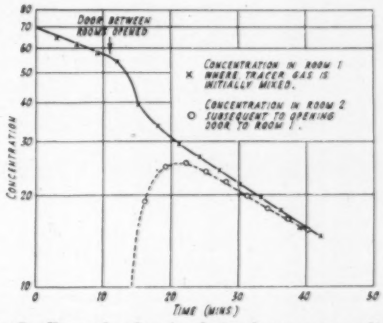

DOOR BETWEEN ROOMS OPENED
CONCENTRATION IN ROOM 1 WHERE TRACER GAS IS INITIALLY MIXED.
CONCENTRATION IN ROOM 2 SUBSEQUENT TO OPENING DOOR TO ROOM 1.
CONCENTRATION
TIME (MINS.)

Fig. 5—Example of recirculation between two adjoining rooms

ment in time. Hence, it is valid when superimposing to neglect the initial measured concentrations and displace the curves in time, if this is necessary to obtain a good fit.

Using the routine method of comparing maxima (the observed value and that calculated from Equation 8) the value of $c_0\frac{x_{1-2}}{v_2}$ in the foregoing example was again estimated to be 17.

2. *Recirculation between Rooms:* When an internal door between two rooms in a house is open, a small temperature difference will cause a considerable amount of recirculation of air to occur between the rooms. This recirculation can be investigated using a tracer gas by mixing the tracer with the air in one room with the door closed, and then opening the door and measuring the subsequent concentrations of tracer in the two rooms; due allowance being made, if required, for the change in density of the air due to the presence of the tracer.

An example of this type of measurement is shown in Fig. 5. In this example interchange between the rooms was rapid, and after the door between them had been opened, the mean concentrations of tracer gas in the two rooms (measured as the average of 10 sampling points in each room) quickly approached the same value. The final rates of decay in the two rooms were very similar; the two rooms in this case could well have been treated as a single space in regard to air change rate. If the air change rates measured in two rooms coupled in this manner do differ appreciably, the rate at which the air in the two rooms is replaced may be obtained from the measured rates of decay when the concentrations of tracer gas in the two rooms are equal.

3. *Whole House Measurements:* The results of a series of measurements of ventilation rates and leakages in rooms of an unoccupied house, in which the doors and windows have fixed degrees of opening, may be correlated with the relevant variables such as wind (speed and direction) and temperature differences, and hence the rates of air flow may be predicted for given values of these variables. It is thus possible by summation throughout the house to estimate the rate at which air enters (or leaves) the house for particular conditions of the controlling variables. Similarly, the rate at which heat is lost from the house by ventilation may be estimated from Equation 5.

When the house is occupied and the tenant is in complete control, the opening of particular doors and windows (which may change at any time) will occur in a range of combinations imposed by the tenant. This large increase in the number of controlling variables makes it practically impossible to correlate the observed rates of air exchange with the outside, and heat loss to outside, by a procedure similar to that adopted in the unoccupied house. Further, the conditions within the house can no longer be considered as subject to small variation throughout the period of a measurement; in particular, internal doors being opened and closed may change the interaction between two rooms from a unidirectional flow to a recirculation or vice versa.

However, if a tracer gas is introduced into the n rooms of a house, the concentrations in the rooms being $c_1, c_2, \ldots c_r, \ldots$, then the rate $G$ at which the tracer gas leaves the house is

$$G = \sum_{r=1}^{n} x_{r-a} c_r \quad \ldots\ldots\ldots\ldots\ldots\ldots (10)$$

The rate $H$ at which heat is lost from the house by ventilation is given by Equation 5. Comparing Equations 5 and 10, if

$$c_r = y(T_r - T_a)$$

the rate of loss of tracer gas $= y/s \times$ (rate of loss of heat) or

$$G = \frac{y}{s}(H)$$

Thus when the concentrations of tracer gas in the rooms are proportional to the corresponding difference between the room and external temperatures, the rate at which heat is lost by ventilation may be obtained from the measured rate of loss of tracer gas. Similarly, the air flow to outside may be obtained from the rate of loss of the tracer gas when the concentrations in the rooms are equal. The method by which measurements of this type have been made in the occupied experimental

Fig. 6—Copper tubes used for introducing tracer gas and extracting air samples

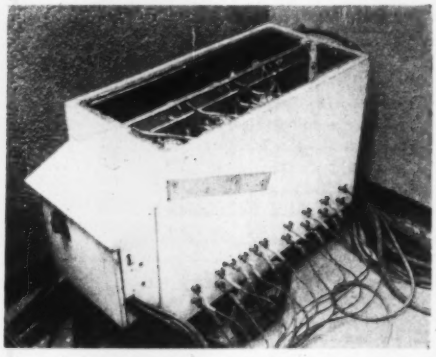


Fig. 7—Mobile trolley in which katharometers are housed

houses is described in the section following.

### Method Used for Ventilation Measurement in the Occupied Houses

In the heating tests as a whole the experimental technique has been designed to avoid interference with the life of the tenant; for instance, room temperatures (air and globe), humidity, window and door opening are all remotely recorded. The technique developed for measuring ventilation in the occupied houses has been fashioned by this requirement, and in its final form allows the measurements to be made without any interference with the tenant, the process being remotely controlled and recorded.

In the experimental houses, a series of ¼ in. copper tubes were installed to permit introduction of a mixture of tracer gas and air from outside to any room; the run and termination of these tubes outside the house is shown in Fig. 6. In each room a tube is mounted on the baseboard around at least three sides of the room and is fitted with blocks (at foot intervals) which are threaded to take motor cycle carbureter jets, the delivery from the jets being horizontal and perpendicular to the wall on which the tube is mounted. The distribution of tracer gas within the room is achieved by sizing the jets according to their position in the supply line (to allow for pressure drop along the tube), and according to the volume of the room served by them—for instance, the jets are smaller in the corners of the rooms. Mixing of the tracer gas with the room air is due partly to the turbulence produced by the jets, but mainly to the entrainment of the tracer in the air currents in the room, there being 30 or 40 jets per room. The distribution is determined by using portable katharometers spaced throughout the room: the results of two tests are shown in Figs. 1 and 2. In these tests the time of injection is usually about 5 to 10 min for helium which was introduced at a concentration of 10 to 20 percent in air, but these values are not very critical as will be seen from the example in Fig. 2, where satisfactory distribution was obtained with a 3 min injection using 60 percent helium in air. In this connection a recent experiment by Lidwell[2] provides an extreme example. He liberated suddenly at a point in a room of 4500 cu ft volume, a quantity of acetoacetic ester vapor and found the circulation time in the room to be about 4 min. After 20 min the vapor was fairly uniformly mixed with the air in the room. Obviously the limits for the time of injection, and the concentration of tracer gas in the incoming mixture which may be used, will depend on the number of points used for injection, the magnitude of the convection currents and the period of circulation of the air masses in the room. These limits have not been investigated in detail in the present experiments in which an empirical approach has been adopted.

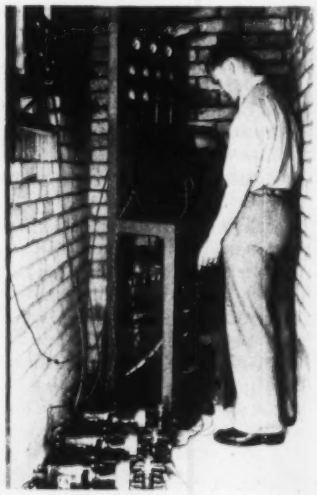


Fig. 8—Recorder hut containing remote controls

A second set of copper tubes was installed in the houses so that a continuous sample of the air in each room may be withdrawn by a vacuum pump and the concentration of tracer gas measured by katharometers. Spaced throughout each room are eight or nine

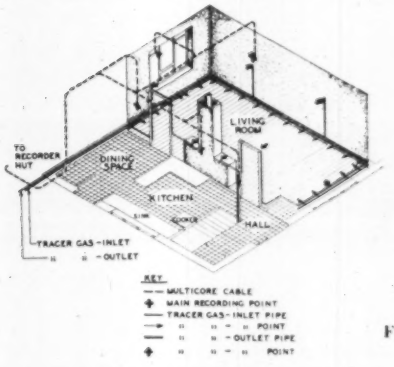



Fig. 9—Schematic drawing showing installations in the houses

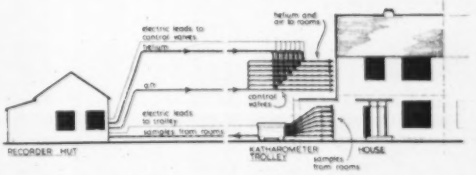



Fig. 10—Schematic drawing of external arrangements for measuring ventilation in the occupied experimental houses

sampling points, also fitted with interchangeable carbureter jets so that the individual flows may be adjusted to obtain a good sample of the air in the room. With the size of tubing used, the rate of flow may be adjusted so that the time of transit of the sample from the room to the outside is negligible, and so that the rate at which air is extracted from the room does not appreciably affect the air change rate.

With the installation as described in an experimental house, the samples of air from the rooms are withdrawn through additional short lengths of connecting tubing past katharometers mounted in a housing on wheels (called a trolley) and shown with lid removed in Fig. 7. The air passing through the trolley flows through a hose to the vacuum pump in the nearby recorder hut, which is shown in Fig. 8. Two additional hoses are run, one to provide the supply of tracer gas and the second to supply air for the injection process. The introduction of helium into particular rooms is controlled by electrically operated valves situated at the trolley. Electrical leads for the valves and the katharometers are also led back to the recorder hut, so that the whole operation of measurement may be controlled and recorded in the hut. Schematic drawings of the experimental arrangements inside and outside the houses are shown in Figs. 9 and 10 respectively.

The equipment described has been used to measure air change rates in the rooms of occupied houses, and also air change and heat loss rates for the whole house by using the principles given, *i.e.* by measuring the rate of loss of tracer gas from the house when the concentrations in the rooms are either equal or proportional to the difference between room and external temperatures. In the latter experiments it has been found convenient to take a longer time for the injection of tracer gas than the 5 to 10 min used in the distribution tests. The periods for most injections are of the order of 30 min which enables the rise of the concentrations in the rooms to be more closely controlled. In practice the concentrations in the rooms are raised to slightly above the required levels and then allowed to decay through these levels. In this way the concentrations at a particular time are very close to those required, and the total rate of loss of tracer gas at these values can be estimated from the curves of decay.

## Results of Applications of the Technique

The techniques described have been applied to the measurement of ventilation in connection with the house heating experiments now being made. The first results of these measurements are included in a recent survey of post-war research on heating and ventilation at the Building Research Station[1].

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## PRESIDENT'S LETTER

Dear Fellow Members in ASHVE:

You will be glad to know, I am sure, the new suit fits pretty good and looks like it would wear well. Possibly a little tight at the seams (maybe diet would help) and maybe one sleeve is a little short, but by and large it doesn't seem to be such a bad buy.

I'm referring, of course, to the By-Laws to go with the new Charter under which we have been operating since January. This note is being written in New York directly following our Council Meeting here, April 16. Some committees met Saturday, and Council used the entire day, Sunday, to get into the "new look."

Almost all your Council members were here and it should be especially noted that the ones coming from the farthest points, such as Reg Taylor and Rollins Gardner from Texas, Don Kroeker from Portland, John Haines from Minneapolis, Spencer Boyd from Atlanta, and Aylmer Hamlet from Montreal, were all here—and on time! I'm always impressed by the interest which compels your representatives to take time from an overcrowded schedule so that they can attend these Committee and Council Meetings, devoted entirely to your problems. They are really on the job!

Council received a report from a Special Committee headed by Ralph Sherman, relative to our research operations. It decided to continue and expand, if possible, our research work. It appointed a new committee on Research Promotion to include R. C. Cross, P. B. Gordon, R. D. Madison, H. A. Lockhart, and John E. Haines representing Council to assist in publicizing research and to attract support. This is the first step in carrying forward an enlarged research program.

Apparently very few By-Law changes may be required, or desired. Each of the committees is working on Rules and Operational Procedures, so that we will have collected, in writing, the accumulation of good practise and instructions. This should help the new appointee in quickly acquiring an understanding of the duties of his job and the best way of going at it. These rules should, of course, be reviewed and revised from time to time and the record kept up to date.

Our present Charter and By-Laws are very broad and direct our attention toward working in the interest of the general public. It is obvious that Heating, Ventilating, and Air Conditioning are closely identified with man's health and comfort. It is very proper that we should take steps to carry forward our own work in the general interest of mankind. We can bring our knowledge and skills to the closer attention of the medical profession, the physiologist, the industrial hygienist, and public health authorities.

Our documents, our literature, our research program, are all directed toward this end. Now it remains to us individually and to the group as an organized engineering society to devote our energies and our treasure to the welfare of the common man. This is our opportunity—and our obligation.

Sincerely,

LESTER T. AVERY, *President*

## *HPACCNA* MEMBERS MEET THIS MONTH

The 61st annual convention of the *Heating, Piping and Air Conditioning Contractors National Association* is being held in San Francisco, the 8th to 11th of this month. The preconvention estimate of Daniel Hayes, San Francisco, indicates that more than 600 delegates, their ladies and affiliates of the industry will swell attendance at convention functions to beyond 1500, the attendance at the 1949 convention in Detroit.

The four-day meeting program, according to Mr. Hayes, includes presentation of outstanding speakers, a review and forecast of industry progress, open forums and discussions on industry problems and a full schedule of social events to balance the serious side of the convention.

Officers of the national association taking part in the meeting include: L. L. McConachie, Detroit, president and member of ASHVE; W. M. Scott, Omaha, vice president; H. E. McGregor, Cambridge, Mass., treasurer; and J. C. Fitts, member of ASHVE, New York, N. Y., executive secretary. In addition to the officers and general chairman, several ASHVE members are directors, including: W. E. Beggs, Seattle; H. W. Goldner, Philadelphia; J. D. Morrow, Houston; W. W. Murray, Jr., New York; W. C. B. Sodemann, St. Louis, a Life Member of ASHVE; K. A. Stephenson, Atlanta; and W. R. Stevens, Cincinnati. Other directors include: R. D. Berry, Chicago; T. L. Eagan, Washington, D. C.; W. F. Henoch, Milwaukee; and Edward Jungbert, Coral Ridge, Ky. Assisting Mr. Hayes on the general committee are Messrs. Nattkemper, Gilley and Nettles, of San Francisco; Messrs. Schmit of Redwood City, Lee of Burlingame, and Sevenson of Oakland.

Host chapter for the convention is the *Heating, Piping and Air Conditioning Contractors Association of Northern California*, San Francisco, the largest industry chapter in the country with the exception of Chicago and New York.

# Welcome to Muskoka

**June 19-21, 1950**

**Wigwasson Lodge, Muskoka, Ont., looking North on Lake Rosseau**

PLANS for the Semi-Annual Meeting, June 19-21, 1950, at the Royal Muskoka Hotel, Ontario, Canada, are proceeding rapidly, according to John H. Fox, general chairman of Committee on Arrangements.

Members of the Society who attend this Semi-Annual Meeting will be treated to surroundings which have made Ontario's Muskoka Lake country one of the finest vacation lands in North America.

The Society's headquarters will be The Royal Muskoka, built across a peninsula which juts into Lake Rosseau, one of the thousands of blue-water lakes in this boating and swimming paradise. Surrounding, to handle the expected overflow, are many other beautiful hotel resorts where members will have the unusual experience of using water taxis for their transportation to and fro, or by car over picturesque roads to The Royal Muskoka.

There will be three technical sessions, one each day, and members will have an opportunity to hear and to express their opinions on such subjects as air conditioning, steam heating, the heat pump, heat flow through glass, the hot-wire anemometer, a psychrometric chart, forced air distribution, performance data on grilles, nozzles and perforated plates, and friction losses in sheet metal elbows. The technical papers will be presented by engineers, each an authority in his field.

As the setting is far removed from the nearest large city (Toronto 150 miles) there will be none of the usual night-clubbing and other activities normally found in cities. But, the visiting members and guests will be treated in many unusual ways to homespun recreation in which all will have an opportunity to take part. Ballroom and square dancing, boat trips for large and small groups, swimming, tennis, golf, riding, and sailing will appeal to many of the sport-minded. Campfires, picnics, and shore dinners will provide an almost universal appeal to all members. Because the setting provides ideal opportunity for family groups, special arrangements are being made to take care of children of all ages.

It is easy to get to the Royal Muskoka by train, plane, or auto. The Committee on Arrangements gives assurance that no *passports* are needed at any port of entry into Ontario or Canada. There is train service to Muskoka Wharf via the Canadian National Railway, leaving Toronto at 11:15 a.m., and arriving at Muskoka Wharf at 1:50 p.m.; a steamboat leaves the Muskoka Wharf at 2:30 p.m. and arrives at the Royal Muskoka Hotel at 5:40 p.m.

Coming by plane, train or bus to Toronto it is a pleasant trip from the city, a center of Canadian industry, to go by train or bus into the northland 150 miles away. By car, the trip from Toronto on good scenic highways, winds through some of the prettiest country in Canada, and by car there is a choice of entry points: The Detroit-Windsor crossing, or at Buffalo, or the Ogdensburg, N. Y.-Cornwall, Ont., border point all are connected to Toronto by modern four and six-lane highways. Northward from the Ontario capital, the route is over Highway No. 11 to Gravenhurst, the Gateway to the North. From there members may head east or west from the stepping-off point to the Muskokas, by either Highway No. 11 through Bracebridge, or by route No. 69, both equally good

**Hotel Rates***

(American Plan—includes meals)

| | Rooms with Private Bath | Rooms with Bath Between | Rooms with Running Water |
|---|---|---|---|
| Royal Muskoka | $16.00 | $14.50 | $11.50 |

*(Reservation forms will come to members by mail)*

*Rates quoted are for per person, per day.

H. D. Henion, *Chairman*
Finance

John H. Fox
*General Chairman*

H. R. Roth
*Secretary*

D. A. Stott, *Chairman*
Banquet

## COMMITTEE ON ARRANGEMENTS

**John H. Fox, *General Chairman***
**A. J. Strain, *Vice Chairman***
**H. R. Roth, *Secretary***

**Banquet**—D. A. Stott, *Chairman;* A. B. Ballagh, D. P. Giffin, J. W. Powlesland.

**Entertainment**—E. G. Spall, *Chairman;* C. J. Bootes, M. K. Bowman, W. F. Graham, A. E. McGruer, G. E. Pallister.

**Finance**—H. D. Henion, *Chairman;* D. L. Angus, Clifford A. Booth, G. R. Mansell, J. H. Ross

**Ladies**—W. W. Miller, *Chairman;* L. M. Bennett, John Thompson. *Assisted by:*—Mmes. M. K. Bowman, G. P. Cooper, W. H. Evans, J. H. Fox, N. W. Kingsland, R. H. Lock, G. S. McKernan, W. W. Miller, William Philip, H. R. Roth, E. G. Spall, D. A. Stott, John Thompson.

**Publicity**—N. W. Kingsland, *Chairman;* K. E. Gould, W. J. Hiscock, James Reith.

**Reception**—G. P. Cooper, *Chairman;* M. C. Bailey, D. Brock, D. H. Butler, J. W. Darling, K. Dewhirst, Robert Dunn, V. J. Jenkinson, J. H. Robinson, E. J. Sandland, H. M. Treleaven, A. W. Wood.

**Sessions**—William Philip, *Chairman;* Thomas Ferguson, M. W. Shears.

**Special Events**—G. S. McKernan, *Chairman;* T. R. Barber, A. M. Dion, Arthur Nearingburg, A. G. Ritchie, N. A. Smith.

**Sports**—R. H. Lock, *Chairman;* Charles Torry, W. J. Usher, Jr.

**Transportation**—W. H. Evans, *Chairman;* W. J. Coates, Ernest Fox, E. C. Lyons, J. L. Neilans.

G. S. McKernan, *Chairman*
Special Events

N. W. Kingsland,
*Chairman,* Publicity

G. P. Cooper, *Chairman*
Reception

E. G. Spall, *Chairman*
Entertainment

W. W. Miller, *Chairman*
Ladies

William Philip, *Chairman*
Sessions

W. H. Evans, *Chairman*
Transportation

R. H. Lock, *Chairman*
Sports

routes on the final lap, to the Royal Muskoka Hotel.

Those coming to Canada for the first time will undoubtedly feel an odd sensation as they pass through the cities of Toronto, Hamilton or Windsor, where the industrial and commercial pulse of the nation is reflected in the tall modern skyscrapers, to the rugged beauties of the North such a short distance away. Above the Muskokas lies the fabulously wealthy mineral belt of Northern Ontario, where nearly all the world's nickel is produced, where uranium, titanium, and other precious metals are being extracted from a rich earth.

In the trip to The Royal Muskoka next month, Society members will have an ideal chance to see a perfect cross-section of Canadian life; the metropolitan air of great cities along the Canadian-American border; the quiet pastoral scene of rich farmlands; the outdoor wonders of Muskoka; and the natural resources which are establishing Canada as one of the foremost trading nations of the world.

# PROGRAM SEMI-ANNUAL MEETING - 1950

## Royal Muskoka Hotel, Ontario, Canada

**Saturday—June 17**

2:30 p.m. Committee on Research, R. C. Cross, *Chairman*

**Sunday—June 18**

Committee Meetings
Council

1:00 p.m. REGISTRATION

4:00 p.m. Ladies Tea
(Evening free for Hotel Concert and movies)

**Monday—June 19**

9:00 a.m. REGISTRATION

9:30 a.m. TECHNICAL SESSION
Welcome Address
Balancing a Steam Heating System by the Use of Orifices, by D. E. Schroeder
Transient Heat Flow Apparatus for the Instantaneous Determination of Thermal Conductivity, by F. C. Hooper and F. R. Lepper
*Thermal Conductivity of Soils for Design of Heat Pump Installations, by G. S. Smith and Thomas Yamauchi

11:00 a.m. Boat Trip for Ladies (box lunches—return by 3:00 p.m.)

12:30 p.m. Welcome Luncheon

2:00 p.m. Golf Tournament for Research Cup and Eichberg Memorial Trophy

2:00 p.m. Shuffleboard, Archery, Bowling, Tennis, Horseshoe Pitching, etc.

8:00 p.m. Informal Get-together (Square Dancing)

10:00 p.m. Camp fires and shore dinner

*To be presented by title

**Tuesday—June 20**

9:00 a.m. REGISTRATION

9:30 a.m. TECHNICAL SESSION
Heat Flow Through Unshaded Glass, by G. V. Parmelee and W. W. Aubele
Effective Solar Absorption of Various Colored Paints, by R. H. Heilman and R. W. Ortmiller
Plant Research in the Phytotron, by Arthur J. Hess
*A Simple Hot-Wire Anemometer, by H. B. Nottage

11:00 a.m. Boat Trip (box lunches); also fast Motor Boat Trip around Islands (both return by 5:00 p.m.)

2:00 p.m. Nominating Committee—R. T. Kern, *Chairman*

2:00 p.m. Golf for Men and Ladies

7:00 p.m. BANQUET—Musical Entertainment and Dancing

**Wednesday—June 21**

9:30 a.m. REGISTRATION

10:00 a.m. TECHNICAL SESSION
A Proposed Psychrometric Chart, by H. B. Nottage
Effect of Temperature on Balance of Air Distribution Systems, by N. A. Buckley, S. Konzo, J. M. David and T. L. Towne
Comparative Study of Ventilating Jets from Various Types of Outlets, by Alfred Koestel, Philip Hermann, and G. L. Tuve
*Energy Losses in 90-Degree Duct Elbows, by D. W. Locklin
Unfinished Business
New Business
Resolutions
Adjournment

12:30 p.m. Farewell Luncheon

# Summary of Chapter Meetings

## AIR POLLUTION DISCUSSED BEFORE WESTERN NEW YORK CHAPTER MEMBERS

*Air Pollution* was the topic of a panel discussion at the February 13 meeting of the Western New York Chapter, held at the University Club, Buffalo, N.Y. J. M. Kane, chief engineer, Dust Control Division, American Air Filter Co., Louisville, Ky., acted as panel chairman and his phase of the discussion was on *Why Confusion on Air Pollution Control?* Mr. Kane was assisted by other leading citizens each of whom addressed the meeting on his particular topic as: *Preserve and Protect —Are Civic Needs*, by W. E. Robertson, attorney for the United Taxpayers League; *Ordinances and Requirements — City of Buffalo*, by John Quinlan, Inspector and Examiner of Engineers; *The Niagara Falls Problem and Ordinances for Control*, by L. A. Crick, acting director, Air Pollution Control; *Practical Design Solutions for Air Pollution Control*, Jacob Fruchtbaum, consulting engineer; *Is Present Day Air Cleaning Equipment Adequate?*, by R. P. Warren, engineer, Buffalo Forge Co. Highlights of the meeting stressed the need for additional legislation clarifying what air pollution is, and the setting of standards to be adhered to for the prevention of air pollution. The discussion also brought out the tremendous strides that have been made since 1945 in bringing about an improvement and reduction in air pollution, as well as statements by the local authorities and their enforcement officers to the effect that industry has been most cooperative in seeking solutions for the prevention of air pollution.

*(l. to r.)* **Western New York Chapter Officers—T. F. Killeen, 2nd vice president; F. J. Weber, president; John Antenner, speaker; J. M. Quackenbush, secretary; J. H. Bryce, 1st vice president**

Another interesting point brought out in the discussion was the classification of air pollution into three groups: (1) smoke abatement (2) curtailment and elimination of industrial waste to the atmosphere and (3) elimination of socalled public nuisances.

Members and guests included most of the leading industrialists of the Niagara Frontier among whom were: L. Lardie, general manager, Electro Metallurgical Corp.; John Antenner, National Aniline and Chemical Co., a division of Allied Chemical and Dye Corp.; representatives of Bethlehem Steel Co.; Republic Steel Corp.; the Carborundum Co.; Symington-Gould Corp.; Worthington Pump & Machinery Corp.; Westinghouse Electric Corp.; and Western Electric Co.

This was one of the outstanding meetings of the year and was attended by 115 members and guests.

• ATLANTA — March 13, 1950. Members of the Atlanta Chapter met at Harris' Tea Room for their regular monthly social hour before dinner. Pres. W. M. Garrard opened the meeting and the February minutes were approved as read. Reports were given by the various committee chairmen and S. W. Boyd an-

**Edwin Woolcock, past president of the Western New York Chapter; M. C. Beman, consulting engineer; C. C. Cheyney, Buffalo Forge Co.; Robert Avery, American Air Filter Co.**

*(l. to r.)* **J. M. Kane, chief engineer, Dust Collecting Div., American Air Filter Co.; Roy Warren, Buffalo Forge Co.; Glen Hickey, National Analine Co., Engineering Div.; Otto Wolfe, National Analine Co., Engineering Div.; W. R. Heath, chief engineer, Buffalo Forge Co.**

nounced that the new City Code was adopted. President Garrard called attention to an invitation to the chapter to hold a dinner meeting at Southern Technical Institute, at which time the laboratories would be kept open and a guided tour would be conducted.

G. D. Guler, vice president, introduced the speaker, J. E. Haines, a member of the Society's Council and vice president, Minneapolis-Honeywell Regulator Co., Minneapolis, who presented a well illustrated talk on *Solar Heating*. His talk, in the opinion of the chapter secretary, established the fact that the several types of solar heating now in the experimental stage had definite possibilities, limited only by geographical location in relation to degree-days. A discussion period followed and President Garrard expressed the appreciation of the chapter to Mr. Haines. Attendance 62.

• BALTIMORE—March 7, 1950. At the close of the Board of Governors meeting, the regular meeting was called to order by Pres. E. L. Crosby in the dining room of the Engineer's Club. In accordance with the by-laws, nominations were received from the floor for five members to serve on the nominating committee, which resulted in the election of the following: A. M. Norris, *chairman*, E. J. Morris, W. J. Law, A. M. K. Kroft, and C. J. Peters. The committee was instructed to report at the next meeting.

Dr. L. P. Herrington, director of research, John B. Pierce Foundation, Laboratory of Hygiene, New Haven, Conn., was introduced as guest of the evening and he discussed as his topic, *The Effect of Temperatures on Human Life*. Dr. Herrington has done research work on this subject for the Pierce Foundation over a period of 20 years. In his talk he pointed out limits of temperature tolerance of the body, the effect of radiation, air movement and still air temperatures, the effect of continuously high or low temperatures on various body processes and the importance of posture in adapting the human body to varying temperature conditions. Following an interesting discussion, the meeting adjourned at 10:00 p.m.

• CENTRAL NEW YORK—March 8, 1950. The meeting was called to order at 8:00 p.m. by A. L. Jones, vice president, following a social hour and dinner at the Hotel Utica, Utica, N. Y. J. H. Carpenter, secretary, reported on the status of dues and then announced that the nominating committee planned to meet within the week and ballots for the election of officers would be mailed well in advance of the next meeting. Mr. Carpenter read a report of the Annual Meeting in Dallas prepared by D. L. Mills. Mr. Mills is expected to give a verbal report at the April meeting at which Prof. C. O. Mackey of Cornell University, Ithaca, will be the featured speaker.

C. M. Ashley, director of research, Carrier Corp., Syracuse, was introduced and talked on *Sound and Its Control in Air Conditioning*. Mr. Ashley discussed this complex subject in an interesting fashion and illustrated many of his points by sound generating and measuring equipment. The many questions asked by the audience were indicative of their great interest in the subject. Although the meeting had officially adjourned, Mr. Ashley remained to answer additional questions. Attendance 36.

• CINCINNATI—March 7, 1950. K. B. Little, president, called the meeting to order at the Engineering Society Headquarters and the minutes of the February meeting were read and approved. Following a report by the treasurer, O. E. Rapp reported for the entertainment committee. M. E. Mathewson reported as chairman of the nominating committee and presented the names of the nominees for the 1950-51 season. C. D. Weaver reported on the activity and negotiations being made to obtain a charter for a chapter in Dayton.

At the conclusion of the business meeting, W. J. Killian introduced D. L. Mills, research engineer, Revere Copper & Brass, Inc., Rome, N. Y., who presented an interesting talk on *Radiant Heating*. He illustrated the methods used in bending pipe and explained his views on the proper method of installing a pipe. There were many pros and cons and Mr. Mills handled the discussion very well. Attendance 56. Attendance ratio 0.27.*

• CONNECTICUT—March 9, 1950. The March meeting was held at the 1711 Inn, Meriden, with Pres. Winfield Roeder presiding. The treasurer reported a substantial balance and the meetings' chairman announced the time and place of future meetings.

E. C. Marsden gave an interesting report on the happenings at the Dallas Meeting. President Roeder announced the appointment of the following to audit the treasurer's report: S. R. Osborne, P. D. Bemis and Peter Fleury.

A very interesting talk was delivered by J. W. May, technical director, American Air Filter Co., Louisville, Ky., on *The Theory and Design of Electrostatic Precipitators*. The meeting adjourned at 10:00 p.m. Attendance 64. Attendance ratio 0.57.

• DELTA—March 14, 1950. Members of the Delta Chapter met at the New Orleans Athletic Club and Pres. R. B. Guest presided. President Guest announced that this meeting, which was the largest turnout of members in several years, was in honor of all past presidents of Delta Chapter. Certificates were presented to past presidents, J. S. Burke and L. V. Busenlener. Similar certificates had been awarded to all other past presidents at some previous date. Nominations for members of the nominating committee

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

were received and resulted in the election by acclamation of Mr. Burke, Mr. Busenlener, L. V. Cressy, G. C. Kerr, and G. E. May.

Mr. Burke then introduced the speaker of the evening, E. B. Stern, Jr., president, WDSU Broadcasting Co., who spoke on *The Rapid Growth of Television*. After his talk Mr. Stern showed a CBS film entitled *Television Today*. Both his talk and film were received with much interest and those in attendance were invited to visit the TV studios of WDSU after the meeting so that they could view an actual telecast from the studios. Attendance 55. Attendance ratio 0.76.

• **DELTA**—February 14, 1950—The Delta members and guests met in the Trophy Room of the New Orleans Athletic Club and the minutes of the previous meetings were read and approved. H. L. Salaun, chairman of the membership committee, gave a report on the progress the committee has made. R. S. Oyer introduced J. R. Vernon, assistant secretary and sales promotion manager, Johnson Service Co., Milwaukee, who delivered an address on *Current Practice in Automatic Temperature Control for Heating and Air Conditioning*. He pointed out the characteristics and uses of modern automatic temperature and humidity control equipment and called attention to the control of special conditions in commercial properties, public buildings, institutions and industries. He used numerous slides to bring out fundamental principles and to illustrate the equipment of the various manufacturers. Mr. Vernon's talk was well received. The meeting adjourned at 8:10 p.m. Attendance 72. Attendance ratio 0.28.

• **GOLDEN GATE** — February 2, 1950. Pres. K. F. Baldwin opened the meeting and welcomed the members and guests. Lester T. Avery, president of the ASHVE and president of Avery Engineering Co., Cleveland, gave a short summary of Society activities including a statement of policies of the new Society officers. He also discussed the new By-Laws and stated that there are now 7,800 members, 43 chapters and 10 student branches. President Avery then delivered a fine talk on *Good Air—Good Work*.

He discussed the importance of air for breathing, for environment and for living and working, as distinct from air for industrial processes. Early physiologists proved, he said, that insofar as temperature is concerned, it is the air environment rather than the air being breathed that causes strain.

President Avery said that studies by modern physiologists have shown that the human body is constantly striving to adjust itself to its environment and there is a strain when environment is not in the neutral or central zone in the range from 69 to 71 deg. He further stated that many physiologists, doctors and engineers are now at work on problems involved in the physiological concept of air. He cited the work of the ASHVE on such problems that are under investigation at its research laboratory in Cleveland and at cooperating colleges and universities where the society sponsors research.

In conclusion, President Avery said, " . . . you and I as individual members of the ASHVE are in a most fortunate position to get this material as soon as it is ready and to benefit from discussions. It is our responsibility to use the information to perfect the handling of air. It is our obligation to know what is good, what is best, and to see to it that in our own way, in our own sphere of influence, we do design and deliver good air."

At the conclusion of President Avery's talk, C. H. Bazille gave a short talk on the advisability of stricter enforcement and interpretation of State registration laws.

Dr. Hart, medical director of Pacific Industrial Hygiene Laboratory extended a standing invitation to Society members to attend the meetings of the *American Association of Industrial Hygienists*. Attendance 59.

• **IOWA**—February 14, 1950. The business meeting was dispensed with as the ASHVE Chapter members were guests of the Mechanical and Railroad Sections of the *Iowa Engineering Society* at the dinner meeting at which J. M. Drabelle of Cedar Rapids spoke on *Centralized Control in Central Western Power Stations*. A talk was also given by Wayne Gasper, Newton, whose subject was *Problems in Production Process Control*, dealing with home laundry equipment. Both talks were enjoyed by the members as reported by C. P. North, Secretary. Attendance 10. Attendance ratio 0.28.

• **KANSAS CITY**—February 6, 1950. Prof. J. F. Sandfort, Mechanical Engineering Dept., Iowa State College, Ames, Ia., was introduced by Vice Pres. W. E. Howarth and gave an interesting talk on *Heat Pump Performance and Applications*, which was followed by a short discussion period.

Pres. Henry Nottberg, Jr., presided at this meeting which was held in the Aladdin Hotel Roof Garden. H. H. Lewis reported as chairman of the membership committee and J. L. Williams, president of the student branch at the University of Kansas, announced that their branch membership was now 20. Attendance 61.

• **MANITOBA**—February 16, 1950. Joseph Harden, Winnipeg Supply and Fuel Co., gave an interesting address on pneumatic spreader coal firing in comparison with bunker fuel oil firing. In view of the small attendance all reports were held over for the next meeting. Attendance 12. Attendance ratio 0.24.

• **MASSACHUSETTS** — March 21, 1950. D. W. Blair, program chairman, introduced Dr. Maria Telkes, Department of Metallurgy, M.I.T., whose subject was *Heating with Solar Energy*. Last year Dr. Telkes spoke before the Chapter on the *Uses of Solar Energy for Space Heating at the Dover House*. Her

discussion at this meeting was based on the actual operating results including the use of the system for comfort cooling during the summer. She also described proposed future installations and practical solutions to problems encountered in the use of solar energy for heating buildings. This meeting was one of the best attended and the audience showed great interest in Dr. Telkes' talk. After a discussion the meeting was adjourned with a rising vote of thanks to Dr. Telkes. Attendance 84. Attendance ratio 0.36.

• MASSACHUSETTS — February 21, 1950. A social hour and dinner was held at the Campus Room of the M.I.T. Graduate House with Pres. W. H. Shipp presiding. R. T. Kern and John Bonner reported on the activities of the Dallas Meeting.

J. B. Wells, executive director, *Independent Oil Men's Association of New England*, presented one of the most interesting talks given before the Massachusetts Chapter on the subject of *An Appraisal of Natural Gas* vs. *Fuel Oils for New England*. Many interesting highlights were brought out in Mr. Wells' talk. He gave a comparison of the cost of natural gas, mixed natural gas and artificial as compared to the cost of No. 2 and No. 6 oil in New England, which showed that oil is cheaper for New England than natural gas or a mixture. Mr. Wells stated that in any proposal to establish a natural gas economy in New England, either for domestic or industrial usage, consideration should be given to the ultimate problem involved in the matter of adequate and dependable supply and the serious questions caused by a wide expansion of usage on one hand with progressive depletion of reserves on the other.

In closing, he referred to a previous speech he had made in which he expressed his opinion that if New England could be persuaded to approach the question of natural gas with its eyes wide open, its perception keen, and its judgment deliberate, it might discover that it was being sold *a bill of goods*. The entire talk was interesting and well received. After an enlightening discussion, the meeting adjourned at 9:45 p.m. with a rising vote of thanks to Mr. Wells. Attendance 42..

• MICHIGAN—March 13, 1950. In the absence of the president, C. F. Donohue, vice president, introduced John James, chief research engineer, McDonnell & Miller, Inc., Chicago. Mr. James held the attention of his audience with an interesting presentation on the subject of *Hot Water Heating Systems*. His talk created a great deal of interest among the members as was evidenced by the enthusiastic and heated discussion that followed. A. V. Hutchinson, Executive Secretary of the Society, was introduced and discussed the forthcoming Semi-Annual Meeting scheduled for Muskoka, Ontario. He also pointed out the change in the By-Laws relative to the handling of applications for new members. Attendance 79. Attendance ratio 0.33.

• MICHIGAN—February 13, 1950. The regular monthly meeting was held at the Horace A. Rackham Memorial Building, Detroit. This was *Past Presidents' Night* and was attended by fourteen of the Chapter's past presidents including: N. W. Calvert, E. E. Dubry, F. J. Feely, G. G. Giguere, W. T. Harms, E. M. Harrigan, E. F. Hyde, F. J. Linsenmeyer, L. L. McConachie, R. K. Milward, W. H. Old, H. E. Paetz, S. S. Sanford, and G. D. Winans. New Chapter members were introduced followed by a report by the treasurer which showed 204 members on the Chapter roll, which includes six Life Members. C. F. Donohue, program chairman, reported on the plans for the future Chapter meetings. The 1948 Past President's Pin was presented to Mr. Hyde who directed the activities of the Michigan Chapter so capably during his term of office. After a brief recess, Mr. Donohue introduced J. W. May, technical director, American Air Filter Co., Louisville, Ky., who gave an excellent presentation on the subject of *Theory and Operation of Electrostatic Air Filters*, which was thoroughly enjoyed as evidenced by the questions asked during the discussion. The meeting adjourned at 10:00 p.m. Attendance 81. Attendance ratio 0.39.

• MINNESOTA—February 6, 1950. Members and guests met at the Curtis Hotel, Minneapolis, and Pres. R. C. Jordan called the meeting to order. M. H. Bjerken gave a report of the lighter aspects of the Dallas Meeting and announced that the Minnesota Chapter was well represented among the 940 Society members who registered. President Jordan also reported on the Annual Meeting as Chapter Delegate and compared the delegates' meetings at Dallas with the one he attended about ten years ago. G. A. Voorhees, director, Application Engineering, *NWAH&AC*, Cleveland, gave a short talk on the live-wire group he found in the Minnesota Chapter.

Prof. A. B. Algren, Experiment Engineering Laboratories, University of Minnesota, guest of the evening, delivered an interesting address on *Radiant Panel Heating Comes of Age*. He pointed out many of the fallacies existing today in our concept of radiant panel heating. Attendance 150. Attendance ratio 0.48.

• MONTREAL—February 6, 1950. The Annual Curling Bonspiel was held at the Montreal West Curling Club with the following serving on the curling committee: T. E. Cockman, W. G. Hole, B. J. Horsburgh, and Jack Wright. The curling trophy was awarded to: J. B. Flanagan, F. A. Hamlet, A. B. Madden, and E. H. Pantel. It was the consensus that the curling bonspiel was a real success with 65 in attendance.

• NEBRASKA—February 14, 1950. Members and their wives and guests were welcomed by C. A. Carter, president of the Chapter, at the

annual dinner at the Hotel Castle. Entertainment consisted of presenting comic valentines to the members and after dinner some enjoyed bridge, canasta, and dancing. There were 18 members, their wives and 19 guests who enjoyed themselves according to the report of the secretary.

• NORTH TEXAS—February 20, 1950. The Melrose Hotel was the meeting place for the monthly get-to-gether of the North Texas Chapter. Pres. Herman Blum opened the meeting and the usual reading of the minutes was the first order of business. These were read and approved. Future programs were announced as follows: March—*Fundamentals of Freon and Ammonia Refrigerants;* April—*Insulation;* May—*Chuck Wagon Dinner;* June—*Centrifugal Fans;* July—*Pumps;* August—*Fans;* September *Controls;* October—*Heating;* November—*Reverse Cycle;* and December—*Dinner Dance.*

C. Rollins Gardner made a few announcements concerning the Annual Meeting stating that the final figures of registration were 2,157 with a total of 8,222 registered at the Exposition at the State Fairgrounds.

The speaker of the evening, Dr. Wayne Rudmose, Department of Physics, Southern Methodist University, Dallas, was introduced by J. W. Lacy. His talk was primarily on *Architectural Acoustics.* He spoke from his own experience and gave the members numerous problems that had confronted him as an acoustical engineer and explained how each had been worked out to the satisfaction of the owner and tenant. A very interesting discussion on acoustics as applied to the building for the prevention of noise transmitted from air conditioning machinery and pumps followed. Attendance 82.

• NORTHERN OHIO—March 13, 1950. *Is Humidity Important in the Air We Breathe?* was the subject of a talk given by L. E. Seeley, first vice president of ASHVE and Dean of the School of Technology, Durham, N. H., at the March meeting of the Northern Ohio Chapter held in the Warner Auditorium of the Cleveland Engineering Society.

Lester T. Avery, president of the Society and president of Avery Engineering Co., Cleveland, introduced Dean Seeley, who in his remarks, emphasized the fact that we learn what optimum humidity is for industrial processes and then produce and control it. On the other hand, little has been done to discover what human humidity requirements are.

Dean Seeley also emphasized that although optimum air conditions for industrial process control are carefully studied, little research has been done to seek optimum conditions for human health. Drawing upon his own experience in pioneering this research, he discussed changes of temperature and humidity of respired air in the nasal cavity. Illustrative slides showed the manner in which the nasal cavity conditions the air we breathe. Dean Seeley described the possible harmful effects due to changes in the moisture equilibrium of nasal tissues brought about by the slow readjustment of these areas to sudden changes in environmental humidity. His answer was in the affirmative to the question, "Is humidity control important for the air we breathe?" Dean Seeley's highly interesting and informative talk drew unusual response in the discussion period that followed. Attendance 65. Attendance ratio 0.27.

• NORTHERN OHIO—February 13, 1950. Members and guests met for dinner in the main dining room of the Cleveland Engineering Society Building and at the opening of the meeting W. M. Rowe gave his report of the activities at the Annual Meeting in Dallas. President Avery discussed briefly the Chapter stationery which, in order to conform to the new By-Laws, should say that the Chapter is an affiliate of the Society. He also pointed out the desirability of having the immediate past president serve on the Chapter Relations Committee. The group then recessed to the Warner Auditorium where Pres. R. L. Byers called the business meeting to order. Following the reading of the minutes, which were approved without changes, and the submission of various reports, J. E. Wilhelm, president of the *Cleveland Technical Societies,* reported that the first issue of Volume I of the new *Journal of the Cleveland Technical Societies' Council* would be published weekly with the first issue ready in March.

President Avery reported that the Annual Meeting in Dallas was an outstanding success in every way. He also complimented the Northern Ohio Chapter on its efficient operation.

J. M. Black introduced the guest of the evening, P. L. Davidson, consulting engineer of Philadelphia, who spoke on *Industrial Air Conditioning,* with particular reference to the textile industry which, he stated, sets the pattern for industrial air conditioning. He described how the effect of constant temperature and humidity is reflected directly in the equipment and the product manufactured. He expressed the opinion that it is possible, through refrigeration, to increase permissible spindle speeds and have less down-time of the equipment. In normal practice, he stated, a temperature of 80 F is used as a base in the design of machinery for the textile industry, and it is important to operate the equipment as near this temperature as possible. Conditions for maintaining a quality product are sought by the use of chilled-water air washers and electrostatic filters, according to the speaker.

Mr. Davidson recommended the construction of plants without windows, thus eliminating the necessity of introducing spot heating at glass areas and reducing summer solar heat gain. Due to the high humidity generally maintained, building materials used should have good thermal qualities to prevent

the formation of condensation on building construction. The meeting adjourned after an informative discussion period. Attendance 80. Attendance ratio 0.31.

• OKLAHOMA—March 13, 1950. Pres. H. S. Shafer presided at the March meeting held in Beverly's Drive-In, Oklahoma City. He reported on the activities of the Student Branch at the Oklahoma A. & M. College and introduced W. H. Moler, regional manager, Governair Corp., Dallas. Mr. Moler spoke on *Unit Room Conditioners and Their Application in the Air Conditioning Field*. Attendance 43. Attendance ratio 0.38.

• ONTARIO—March 8, 1950. Pres. A. J. Strain opened the March meeting in the Royal York Hotel with dinner preceding the meeting. J. H. Fox, general chairman, Committee on Arrangements, reported on the progress being made in the plans for the Semi-Annual Meeting to be held at the Royal Muskoka, Ontario, in June. Dr. K. R. Rybka, consulting engineer from Toronto, delivered a talk on *Heating, Ventilating and Air Conditioning in the New Bank of Nova Scotia Building, Head Office, Toronto*. A discussion followed. Attendance 124. Attendance ratio 0.47.

• OREGON—February 6, 1950. Pres. J. P. McDermott called the meeting to order at 7:00 p.m. and the January minutes were approved as read. T. E. Taylor, chairman of the legislative committee, reported that the forced air code was being studied and the committee would have a report ready for the next meeting. W. B. Morrison reported for the nominating committee and after a brief recess Lester T. Avery, president of the Society and president of the Avery Engineering Co., Cleveland, was introduced as the featured speaker of the evening. President Avery gave an instructive talk on *Dynamic Air Conditioning*. The meeting adjourned at 10:00 p.m. Attendance 80.

• PHILADELPHIA—March 9, 1950. F. H. Buzzard, president, presided at the March meeting held at the Engineers' Club and the minutes of the previous meeting were approved as read. Following a report by the treasurer, Lawrence Macrow, chief engineer, Carrier Corp., Philadelphia, spoke on the *Four Season Air Conditioning for Skyscrapers*. He illustrated his talk with slides and a lively discussion period followed. Attendance 82. Attendance ratio 0.30.

• PITTSBURGH—March 13, 1950. The meeting was called to order by H. J. Kirkendall, president of the Chapter, in the Hunt Room of the Webster Hall Hotel. Reports were submitted by committee chairmen, C. M. Fife, R. J. Doherty, and A. F. Metzger, for the membership, attendance, and program committees respectively. C. F. Schneider, reported as Chapter Delegate to the Dallas meeting, and then announced that the Semi-Annual Meeting would be held at the Royal Muskoka Hotel, Ontario, June 19-21, and the 1951 Annual Meeting in Philadelphia. President Kirkendall appointed members of the nominating and entertainment committees as follows: *Nominating*—J. L. McCann, *chairman;* J. J. Kelly, E. W. Meyer, C. F. Schneider; *Entertainment*—F. C. McIntosh, *chairman;* D. W. Loucks, H. E. Park. Mr. Metzger then introduced the speaker, G. DeCroce, engineering supervisor of the Central Engineering and Service Department of Westinghouse Electric Corp., who spoke on *Fundamentals of Electronics and Their Applications*. He described electronics as the science that treats with the flow of electricity in a vacuum tube by means of an electron. He illustrated his talk with numerous slides including a view of the television tube and the principles on which it works. After a discussion on the subject, the meeting adjourned at 10:15 p.m. Attendance 41.

• ROCKY MOUNTAIN—March 19, 1950. Dinner preceding the meeting was held at the Silver Wing Inn, Englewood, Colo., where Pres. E. J. McEahern opened the meeting. Following the reports of the various committee chairmen, J. R. Vernon, assistant secretary and sales promotion manager, Johnson Service Co., Milwaukee, gave a talk on *Current Practice in Automatic Temperature Control for Heating and Air Conditioning*. He also described in detail, pneumatic control, different types of valves, thermostats, dampers, and explained how these components are fitted into different types of systems. His talk was well received and a vote of thanks was given to Mr. Vernon. The meeting adjourned at 10:15 p.m. Attendance 77. Attendance ratio 0.43.

• ST. LOUIS—March 2, 1950. Pres. W. A. Russell opened the meeting in the York Hotel and called upon H. C. Sharp, secretary of the Chapter, who presented a Life Membership certificate to E. P. Bradley, one of the founders of the St. Louis Chapter. Mr. Sharp, in making the presentation, pointed out that Mr. Bradley's career started with his connection with the Paul system in 1898 and carried him through his various business connections and service during two world wars. It was brought out that during his career he trained nine of the heating engineers now actively engaged in the profession in St. Louis. In his speech of acceptance, Mr. Bradley recounted many interesting details of the early history of steam heating. His talk, although brief, was one of the highlights of the 1949-50 season, according to Secretary Sharp's report.

President Russell then called for nominations from the floor for three members to serve on the nominating committee which resulted in the election of L. W. Moon,

W. A. Klein, and G. B. Rodenheiser.

The meeting at the York Hotel was adjourned at 8:00 p.m. and was resumed at 8:25 p.m. at the Engineers' Club. Earl Salveter, president of the Club, introduced Chapter officers, W. A. Russell and J. S. Rosebrough, president and vice president, respectively. Mr. Rosebrough is also president of *ASRE*.

Prof. B. H. Jennings, Department of Mechanical Engineering, Northwestern University, Chicago, was introduced and delivered a talk on *Air Sterilization and Human Health*. An abstract of Professor Jennings' talk follows:

Air borne diseases are high during the winter months and can be reduced by various methods as follows: (1) by use of 100 percent outside air (2) use of electronic dust precipitators to take the dirt out of the air, which often acts as a vehicle to carry in germs and bacteria (3) use of ultra violet rays (4) chemical sterilization of the air.

Ultra violet light in direct room application is hard on the eyes and must be shielded to prevent conjunctivitis. This shielding reduces efficiency. To be effective, 100 micro watts are required; whereas, humans can stand but one-tenth of one micro watt.

Ultra violet can be used in the duct work, but this then would be effective only on the air going through the duct and does not become effective on the total air in the room.

During the War, research and experimentation in chemical sterilization of air in congested spaces was carried on with glycol vapors. Triethylene glycol, because it requires one-sixtieth of the amount of propylene glycol, has attained great favor. It is highly hygroscopic and infinitely miscible with water and is nontoxic in usual concentrations (slides were shown illustrating the effectiveness of this on staphylococcus germs).

The optimum humidity for general effectiveness is between 40 and 60 percent; below 20 percent relative humidity glycol addition to the air is of little value. The optimum condition reported was 60 percent relative humidity and 72 F dry bulb. Application patents for glycol had been turned over to the Research Corporation who would readily license any legitimate manufacturer of approved dispensers for a nominal fee. All vaporizers offered to the market have not been licensed and some of them are of little value and are not approved by the profession.

Professor Jennings' talk was terminated with a rising vote of thanks from the group in attendance after which a spirited question and answer period followed. The meeting adjourned at 9:45 p.m. Attendance 24.

• **SOUTHERN CALIFORNIA**—March 1, 1950. *The Air Conditioning Contractor Views Collaboration Among Architects, Engineers, ASHVE Trades, and Other Contractors*, was the topic discussed at the March meeting held at Conde French Restaurant, Beverly Hills. The speaker, F. J. Park, president, Western Air & Refrigeration, Inc., Los Angeles, stated that he felt, as a contractor, the architect and consulting engineer should make more complete, detailed plans and specifications so that fewer items are left to chance to the detriment of other contractors bidding for the installation as well as to the owner. He cautioned suppliers of equipment to contact heating engineers first with their new specification details, rather than contractors, so the contractor will know well in advance the engineer's attitude on the equipment in question.

J. W. Hill, consulting engineer, asked Mr. Park about his ideas on *or equal* clauses in specifications and the speaker felt that the architect and engineer should maintain a list of *or equal* items or specify more names in his specification which he considers equal. W. H. C. Ness, president, Master Fan Corp., represented the manufacturer in the discussion and he asked for more consideration for local manufacturers who are making equal quality equipment. F. J. Keeler, heating and ventilating supervisor, Los Angeles Board of Education, represented the owner and his main interest was the poor workmanship he is receiving on new school work. A general open discussion period followed and the response was excellent. The meeting was adjourned at 10:00 p.m. by Pres. J. L. Blake. Attendance 100. Attendance ratio 0.57.

• **WASHINGTON, D. C.**—The Hotel 2400 was the meeting place for the March meeting at which Pres. P. R. Achenbach presided. The members voted to approve the minutes of the previous four meetings as written by the secretary without reading. The nominating committee presented the slate of officers for the 1950-51 season and the results will be announced at the next meeting. President Achenbach reported as delegate to the Dallas Meeting.

The president then introduced Laurence Shuman, chief, Mechanical Engineering Section, *National Housing Agency*, who presented a paper on *Performance of Masonry Chimneys for Houses*, which dealt with all phases of masonry chimney design and was augmented by slides. Mr. Shuman received the Chapter's sincere thanks not only for a commendable presentation of the subject but also for filling in at the last moment for the announced speaker who was unable to attend. The meeting adjourned at 10:15 p.m. Attendance 34. Attendance ratio 0.30.

• **WISCONSIN**—February 20, 1950. Wisconsin Chapter held its February meeting at the Engineers' Society Building in Milwaukee. Dinner was served before Pres. B. M. Kluge formally called the meeting to order at 7:48 p.m. President Kluge gave a brief resumé of the Annual Meeting in Dallas and announced that Ernest Szekely, a past president of the Chapter, had been elected second vice president of the Society and that J. R. Vernon had been named vice chairman of the Chapters' Conference Committee. T. I. Byrd, sales manager of the Lau Blower Co., Dayton, Ohio, was introduced by F. J. Nunlist, Jr. Mr. Byrd spoke on *Attic Ventilation—A Source for Comfort*. He described the various methods of installing propeller fans in residences to utilize the cool air given at night to increase comfort and explained

that *night air cooling* is not strictly air conditioning, but can be a practical source of comfort. He demonstrated both window type and panel type fans with actual displays and outlined testing standards for this type of equipment. He further pointed out that the market for such fans is rapidly growing especially in the Northern States. Following his talk, Mr. Byrd answered many questions and after a rising vote of thanks, the meeting adjourned at 9:10 p.m. Attendance 31. Attendance ratio 0.29.

## STUDENT BRANCHES

▲ **CCNY**—March 15, 1950. Pres. Seymour Oestreicher called the meeting to order in the Technology Building. Irving Furst, representing the Intrasociety and Intrafraternity Council of the Technology School, gave his report on the progress of the proposed Tech Theater which is to show films of interest to all members of the Technology School. Three films were shown, the first of which was entitled *Steam Power for American Sea Power*, depicting the fabrication and installation of marine boilers in a destroyer. It also showed some excellent scenes on the welding of the boiler components. One of the interesting features of the film showed the assembly of the components—the steam and water drums, boiler tubes, superheater tubes, etc., as a complete unit before its installation in the ship. The film was shown through the courtesy of Babcock & Wilcox Co.

The second film shown was an Encyclopedia Brittanica film entitled *Atomic Power*, which explained, by the use of animated diagrams, the principals of transmutation and fission of the elements. It also showed clearly how atomic energy is obtained by the conversion of mass to energy.

The third film, *The Distribution of Heat Energy*, showed how heat is distributed by warm air, steam, and hot water heating systems. All films were thoroughly enjoyed and the meeting was considered well worthwhile. Attendance 29. Attendance ratio 0.54.

▲ **CCNY**—February 15, 1950. The discussion during the meeting was devoted mainly to plans for increasing the student branch membership. It was announced by the president that student branch application blanks could be obtained any time between the hours of 11:00 and 2:00 p.m. A motion was made and passed that meetings of the student branch be held on alternate Wednesdays and it was also decided that the officers should hold an executive meeting every Thursday. President Oestreicher brought up the matter of attendance at previous meetings and after some discussion of this problem, it was decided that due to the late hour of the meetings the best inducement for members to attend would be to show films pertaining to the heating and ventilating field. A committee was named for the purpose of obtaining these films. The meeting adjourned at 6:20 p.m. Attendance 37. Attendance ratio 0.74.

▲ **PURDUE UNIVERSITY**—March 1, 1950. D. M. Williams, chairman of the student executive committee of the Purdue Student Branch, opened the meeting in the Mechanical Engineering Building at 7:30 p.m. Following the usual order of business, Chairman Williams turned the meeting over to R. L. Ford who introduced C. F. A. Locke, branch manager, Minneapolis-Honeywell Regulator Co., Indianapolis. Mr. Locke opened his remarks with a brief outline of the history of automatic controls and continued by stating that 3 factors influenced the development of automatic controls: (1) World War I; (2) gas heating; and (3) automatic coal firing.

The speaker pointed out the difficulties in the location of controls in public buildings and then cited the benefits and objections to individual controls. The problems that arise when buildings have both north and south exposure were then discussed by Mr. Locke. He described a type of automatic control system that can be used in a school building and concluded his talk by stressing the importance and necessity of automatic controls and warned against the over-control of any system. The students were well pleased with Mr. Locke's presentation and the meeting adjourned at 8:00 p.m. Attendance 47. Attendance ratio 0.39.

▲ **TEXAS A & M**—February 28, 1950. The students met in the Lecture Room of the Mechanical Engineering Building and Pres. J. E. Schumann opened the meeting. Prof. L. S. O'Bannon joined in the discussion of the various items of business brought before the meeting. The newly appointed committees were announced as follows: *Engineering*—C. F. Cogan, J. S. Denning, W. A. Galbreath, W. E. Richard and J. E. Schumann; *Membership*—C. F. Cogan, W. E. Richard and M. C. West; *Placement*—W. W. Bishop, Charles Luedtke; *Program*—R. A. Hall and J. E. Schumann.

Mr. Richard introduced the guest of the evening, A. S. Avary of the Stanley Equipment Co., Bryan, Tex., who spoke on his personal applications of air conditioning. The meeting was adjourned by President Schumann. Attendance 15. Attendance ratio 0.31.

▲ **UNIVERSITY OF KANSAS**—February 23, 1950. J. L. Williams, president of the University of Kansas Student Branch, opened the regular meeting in Lindley Hall auditorium and asked for suggestions for ASHVE participation in the Annual Engineering Exposition. The speaker, Van Sparks, branch manager of the Frick Co. (Inc.), Kansas City, Mo., chose as his subject *New System of Recompression Evaporation* with special emphasis on the concentrating of fruit juices. Following the talk, an open discussion took place with Mr. Sparks acting as moderator. Attendance 20. Attendance ratio 0.70.

▲ **UNIVERSITY OF TEXAS**—March 6, 1950. Pres. L. T. Davis called the meeting to order and announced

the plans for a joint meeting with the Southwest Texas Chapter on the anniversary of the organization of the Student Branch, scheduled for April.

R. O. Bredthauer was appointed chairman of the placement committee to cooperate with the Texas Chapters to secure employment for the Student Branch members upon graduation. Prof. W. E. Long volunteered his services to aid this committee and then introduced T. N. Inglis, Jr., engineer in charge of installation and air conditioning at the University of Texas Health Center. He stressed the need for coordination of the engineer, architect, and general contractor and discussed the conduit system as well as the installation problems at the Center. The meeting adjourned at 9:00 p.m. Attendance 23. Attendance ratio 0.50.

▲ UNIVERSITY OF TEXAS—February 7, 1950. The students met at the Engineering Building and President Davis presided. L. E. Scott, vice president, introduced the members of the membership committee and complimented them for the excellent job of bringing in new members. Professor Long introduced B. P. Fisher, owner, Southern Furnace and Supply Co., Houston, Tex., and member of the South Texas Chapter, who talked briefly on the *Leadership in the Young Engineer*. He asked the students for suggestions as to possible papers for presentation at the 1950 Southwest Air Conditioning Conference.

Professor Long also introduced the guest speaker, W. A. Collins, Lone Star Gas Co., Dallas, member of the North Texas Chapter, who addressed the meeting on *Natural Gas Engine in Air Conditioning and Refrigeration*. His talk was not only interesting and instructive but well received by the students.

Mr. Fisher introduced a fellow member of the South Texas Chapter, D. M. Mills, manager, F. J. Evans Engineering Co., Houston, who suggested the formation of a committee to work in cooperation with the South Texas Chapter on the placement of graduates. The meeting adjourned at 9:40 p.m. Attendance 22. Attendance ratio 0.44.

# *Candidates for Membership*

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Executive Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month, 128 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Executive Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by May 25, 1950, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Executive Secretary immediately after election.

ALLEN, R. W., Asst. Prof., University of Maryland, College Park, Md. REFERENCES: P. R. Achenbach, R. S. Dill, C. A. Shreeve, Jr.*, J. E. Younger*.

ANDERSON, O. A., Superintendent, Jamar-Olmen Co., Chicago, Ill. REFERENCES: H. E. Anderson, G. W. Bornquist, J. G. Heitman, H. E. Litwack.

BEAUBIEN, R. J., Engr., V. J. Hagan Co., Inc., Sioux City, Iowa. REFERENCES: P. R. Duitch, F. S. Farkas, W. V. Hagan, D. E. Hartnett.

BLOXHAM, A. T., Sales Engr., Joy Manufacturing Co., San Francisco, Calif. REFERENCES: E. A. Fernsten, J. M. Marr, J. D. Mitchell, S. W. Terry.

BOLLMAN, W. R., Gen. Mgr., E. J. Koykka Sheet Metal Works, Ashtabula, Ohio. REFERENCES: J. H. Christman, J. L. Frisse, W. M. Rogers, R. W. Sheldon.

BRETON, P. L., Engr., O. K. McCullough Co., Kansas City, Mo. REFERENCES: D. M. Allen, T. I. Harriman, H. H. Lewis, Henry Nottberg, Jr.

BROWN, E. D., Dist. Mgr., C. A. Dunham Co., Ltd., and The Powers Regulator Co., Halifax, Nova Scotia, Canada. REFERENCES: C. J. Bootes, Ernest Fox, H. D. Henion, D. A. Stott.

CASSING, E. F., Field Engr., General Heating & Cooling Co., Kansas City, Mo. REFERENCES: V. N. Elder, C. A. Flarsheim, C. W. Schumacher, R. W. Upham.

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DAVIDSON, T. J., Development Engr., Robertshaw-Fulton Controls Co., Los Angeles, Calif. REFERENCES: S. G. Eskin, W. J. Hajek, J. C. Mueller, R. J. Petersen.

ESSEX, H. J. G., Mgr. of Sales and Heating, Frank Hockett Supply Co., Greensboro, N. C. REFERENCES: C. Z. Adams, M. F. DuChateau, G. B. Rottman, W. H. Sullivan, Jr.

FERRELL, M. E., JR., Sales, Crane Co., Atlanta, Ga. REFERENCES: F. E. Baird, W. D. Crawford*, G. B. Curtis, Jr., R. B. Kitch.

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GALLO, R. G. J., Jr. Engr., Voorhees, Walker, Foley & Smith, New York, N. Y. REFERENCES: P. A. Green, J. J. Kopecky, C. N. Mattioli, A. L. Zigas.

GARRARD, O. G., Mgr.-Director, F. A. Sharman (Pty.) Ltd., Johannesburg, South Africa. REFERENCES: J. Fassler*, N. H. Gilfillan*, W. A. McKechnie*, E. G. Moore*.

GREGG, E. F., Sales Engr., Barnes & Jones, Inc., New York, N. Y. REFERENCES: W. E. Barnes, H. B. Eells, C. W. Larson, N. J. H. Shaw.

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GROSSMAN, R. H., Owner, R. H. Grossman Sheet Metal and Heating Contractor, Denver, Colo. REFERENCES: F. L. Adams, N. H. Brickham, J. J. Johnson, William Van Genderen.

HEATON, J. B., Sales Engr., George Q. McNamara, Inc., Detroit, Mich. REFERENCES: Sigman Gendein, E. F. Glanz, G. Q. McNamara, F. L. Pearson.

HEIMAN, J. L., Engr., International Oil Burner Co., St. Louis, Mo. REFERENCES: J. B. Killebrew, G. B. Rodenheiser, W. A. Russell, H. C. Sharp.

HELLBERG, E. N., Mech. Engr., USN Civil Engr. Research & Evaluation Laboratory. REFERENCES: C. R. Freberg*, L. J. Helms, R. C. Snow, Warren Viessman.

HENDERSON, J. R., SR., Owner, J. R. Henderson Co., Oklahoma City, Okla. REFERENCES: N. B. Ash, W. M. Carroll, D. R. Groth, R. E. Swan.

HILMER, MILTON, Asst. Works Supt., Sarco Manufacturing Corp., Bethlehem, Pa. REFERENCES: T. N. Adlam, Louis Barfus, Martin Christesen, T. R. Stevens.

HOFFMAN, L. G., JR., Supt. Insulation Dept., Jamar-Olmen Co., Chicago, Ill. REFERENCES: H. E. Anderson, G. W. Bornquist, J. G. Heitman, H. E. Litwack.

HOMBSCH, C. E., Designer, Industrial Heating & Engineering Co., Milwaukee, Wis. REFERENCES: A. F. Bowers, D. W. Davis, Jr., J. E. Illingworth, F. J. Orians.

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LONG, W. L., Partner, Chicago Conditionaire Co., Chicago, Ill. REFERENCES: H. E. Anderson, J. G. Heitman, H. E. Litwack, L. H. Streb.

MALAHY, J. S., JR., Engr., Landauer & Guerrero, Shreveport, La. REFERENCES: W. S. Evans, W. E. FitzGerald, M. A. Hudson, Bernard Segall, Jr.

MARSHALL, G. K., Direct Sales Repr., General Electric Co., Chicago, Ill. REFERENCES: G. G. Freyder, Vern Hagmann*, Herbert Kreisman, H. G. Swart.

MARTIN, W. B., JR., Mech. Engr., Cary B. Gamble & Assoc., New Orleans, La. REFERENCES: P. E. Coe, Jr., Ralph Elizardi, E. H. Sanford, T. A. Stokes.

MCGUIRE, N. W., JR., Sales Engr., American Blower Corp., Charlotte, N. C. REFERENCES: H. R. Denny, E. S. deWitt, M. F. DuChateau, J. G. Johnson, Jr.

METCALFE, W. K., Secretary, J. O. Ross Engineering Corp., New York, N. Y. REFERENCES: H. S. Dutcher, W. L. Fleisher, S. W. Fletcher, J. O. Ross.

MOORE, W. H., Sales Engr., Minneapolis-Honeywell Regulator Co., Syracuse, N. Y. REFERENCES: C. R. Acheson, R. A. Baker, O. H. Hellekson, J. W. Stevens.

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## OBITUARIES

### EDWIN A. GORDON, III

**Austin, Tex.**

Word has been received of the tragic death of Edwin A. Gordon, III, Austin, Tex., on March 23, who died from suffocation and burns received when he was trapped in the basement of the T. H. Williams Co. store, when a raging fire broke out.

Mr. Gordon, who was a Junior Member of the ASHVE, was one of a five-man crew from Climate, Inc., a local air conditioning company.

Mr. Gordon, a resident of Gilmer for many years, was born on March 23, 1922, at Wichita Falls, Tex. He was graduated from Gilmer High School and received his B.S. in mechanical engineering from Texas A & M College. His family moved to Austin in 1944.

Following his graduation, he entered the Army Air Force as a fighter pilot and saw active duty in England and the European theater. He remained with the Army of Occupation until June 1948 when he received his discharge.

Mr. Gordon is survived by his parents, Mr. and Mrs. Edwin A. Gordon, Jr.; two sisters, Mrs. Frank Denison, Jr. and Mrs. Ralph Davis; and two brothers, Robert L. Gordon and James A. Gordon, all of Austin.

Funeral services for Mr. Gordon were held at the Weed-Corley Funeral Home and burial was in Austin Memorial Park.

### CHARLES PAT ATKINSON

**Austin, Tex.**

After a long illness, Charles Pat Atkinson, a Student Member of the ASHVE, passed away in Lubbock, Tex., March 3, 1950.

He was born on October 24, 1925, in Lubbock and was graduated last June 1949 from the University of Texas, Austin, with a B.S. degree in mechanical engineering. He was a member of the Student Branch of the Society at the University.

He is survived by his widow, Mrs. Catherine Atkinson of 804 Featherston St., Cleburne, Tex., to whom the Officers and Council of the Society extend their sincere sympathy.

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• **CINCINNATI:** Organized 1932. Headquarters, Cincinnati, Ohio. Meets, First Tuesday. PRESIDENT, K. B. Little, 832 Temple Bar Bldg., Cincinnati 2. SECRETARY, D. J. Wood, 659 E. Sixth St., Cincinnati.

• **CONNECTICUT:** Organized 1940. Headquarters, New Haven, Conn. Meets, Third Thursday. PRESIDENT, D. M. Hummel, 20 Ashmun St., New Haven. SECRETARY, G. F. Nieske, 794 Bee St., Meriden.

• **DELTA:** Organized 1939. Headquarters, New Orleans, La. Meets, Second Tuesday. PRESIDENT, R. B. Guest, 827-37 Dryades St., New Orleans 13. SECRETARY, Theodore Offner, 1000 S. Peters St., New Orleans.

• **GOLDEN GATE:** Organized 1937. Headquarters, San Francisco, Calif. Meets, First Thursday. PRESIDENT, Karl F. Baldwin, Jr., 419 Kentucky Ave., Berkeley 7. SECRETARY, Thomas J. Janes, University of California, Berkeley 4.

• **ILLINOIS:** Organized 1906. Headquarters, Chicago, Ill. Meets, Second Monday. PRESIDENT, J. S. Kearney, 1905 Greenleaf St., Evanston. SECRETARY, G. W. Bornquist, 629 W. Washington Blvd., Chicago 6.

• **INDIANA:** Organized 1943. Headquarters, Indianapolis, Ind. Meets, Fourth Friday. PRESIDENT, W. R. Fenstermaker, 937 Architects & Builders Bldg., Indianapolis 4. SECRETARY, F. C. Barton, 938 K of P Bldg., Indianapolis.

• **IOWA:** Organized 1940. Headquarters, Des Moines, Ia. Meets, Second Tuesday. PRESIDENT, D. E. Wells, 304 Home Federal Bldg., Des Moines 9. SECRETARY, C. P. North, P.O. Box 833, Des Moines 4.

• **KANSAS CITY:** Organized 1917. Headquarters, Kansas City, Mo. Meets, First Monday. PRESIDENT, Henry Nottberg, Jr., 914 Campbell, Kansas City 6. SECRETARY, C. W. Schumacher, 1922 Grand Ave., Kansas City 9.

• **MANITOBA:** Organized 1935. Headquarters, Winnipeg, Man., Canada. Meets, Third Thursday. President, A. W. Moss, 268 Yale Ave., Winnipeg. Secretary, C. M. Fleming, 447 Main St., Winnipeg.

• **MASSACHUSETTS:** Organized 1912. Headquarters, Boston, Mass. Meets, Third Tuesday. PRESIDENT, D. W. Blair, 87 Withington Rd., Newtonville 60. SECRETARY, W. A. Williams, 10 Sevinor Rd., Marblehead.

• **MEMPHIS:** Organized 1944. Headquarters, Memphis, Tenn. Meets, Third Monday. PRESIDENT, W. L. Wellford, Jr., 730 S. Third St., Memphis 2. SECRETARY, A. T. Bevil, 1521 Waverly Ave., Memphis 6.

• **MICHIGAN:** Organized 1916. Headquarters, Detroit, Mich. Meets, First Monday after 10th of month. PRESIDENT, L. A. Burch, 5853 Hamilton Ave., Detroit 2. SECRETARY, J. H. Spurgeon, 23501 Hoover Rd., Van Dyke.

• **MINNESOTA:** Organized 1918. Headquarters, Minneapolis, Minn. Meets, First Monday. PRESIDENT, R. C. Jordan, University of Minnesota, Minneapolis 14. SECRETARY, E. F. Snyder, Jr., 4324 Zenith Ave., N., Minneapolis 12.

• **MONTREAL:** Organized 1936. Headquarters, Montreal, Que., Canada. Meets, Third Monday. PRESIDENT, R. R. Noyes, Rm. 674, Sun Life Bldg., Montreal. SECRETARY, T. G. Anglin, 540 Prince Albert Ave., Montreal 6.

• **NEBRASKA:** Organized 1940. Headquarters, Omaha, Neb. Meets, Second Tuesday. PRESIDENT, C. A. Carter, 3019 Grebe St., Omaha 12. SECRETARY, K. E. Martin, 203 Patterson Bldg., Omaha 2.

• **NEW YORK:** Organized 1911. Headquarters, New York, N. Y. Meets, Third Monday. President, H. S. Johnson, 39 Cortlandt St., New York 7. Secretary, Carl H. Flink, Room 3000, 51 Madison Ave., New York 10.

• **NORTH CAROLINA:** Organized 1939. Headquarters, Durham, N. C. Meets, Quarterly. PRESIDENT, M. F. DuChateau, 205 S. Lyndon St., Greensboro. SECRETARY, G. B. Rottman, 401 S. Chapman St., Greensboro.

• **NORTH TEXAS:** Organized 1938. Headquarters, Dallas, Tex. Meets, Third Monday. PRESIDENT, Herman Blum, 2812 Fairmount, Dallas 4. SECRETARY, R. E. Allison, 607-11 First Ave., Dallas 10.

• **NORTHEASTERN OKLAHOMA:** Organized 1948. Headquarters, Tulsa, Okla. PRESIDENT, A. D. Holmes, 323 W. First St., Tulsa. SECRETARY, J. N. Watt, 528 E. Fifth St., Tulsa.

• **NORTHERN OHIO:** Organized 1916. Headquarters, Cleveland, Ohio. Meets, Second Monday. PRESIDENT, R. L. Byers, 1740 E. 12th St., Cleveland 14. SECRETARY, G. V. Parmelee, 94 Solon Rd., Chagrin Falls.

• **OKLAHOMA:** Organized 1935. Headquarters, Oklahoma City, Okla. Meets, Second Monday. President, H. S. Shafer, 400 Key Bldg., Oklahoma City 2. Secretary, R. E. Swan, 2 N. W. Sixth St., Oklahoma City.

• **ONTARIO:** Organized 1922. Headquarters, Toronto, Ont., Canada. Meets, First Monday. PRESIDENT, A. J. Strain, 474 Bathurst St., Toronto. SECRETARY, H. R. Roth, 57 Bloor St., W., Toronto, Ont.

• **OREGON:** Organized 1939. Headquarters, Portland, Ore. Meets, Thursday after First Tuesday. President, J. P. McDermott, 308 Dekum Bldg., Portland 4. Secretary, K. H. Hanson, 6317 S.E. 40th St., Portland.

• **PACIFIC NORTHWEST:** Organized 1928. Headquarters, Seattle, Wash. Meets, Second Tuesday. PRESIDENT, J. D. Sparks, 7331 W. Green Lake Way, Seattle 3. SECRETARY, W. B. Pride, 3228 37th Pl., Seattle 44.

• **PHILADELPHIA:** Organized 1916. Headquarters, Philadelphia, Pa. Meets, Second Thursday. President, F. H. Buzzard, 213-15 S. Broad St., Philadelphia 7. Secretary, C. F. Dietz, 3449 W. Indiana Ave., Philadelphia 32.

• **PITTSBURGH:** Organized 1919. Headquarters, Pittsburgh, Pa. Meets, Second Monday. PRESIDENT, A. F. Metzger, 435 Sixth Ave., Pittsburgh 22. SECRETARY, E. H. Riesmeyer, Jr., 231-33 Water St., Pittsburgh 22.

• **ROCKY MOUNTAIN:** Organized 1944. Headquarters, Denver, Colo. Meets, First Wednesday. PRESIDENT, E. J. McEahern, 1146 Market, Denver 4. SECRETARY, N. H. Brickham, 2715 S. Humboldt, Denver.

• **ST. LOUIS:** Organized 1918. Headquarters, St. Louis, Mo. Meets, First Tuesday. PRESIDENT, W. A. Russell, 7918 Kingsbury Blvd., Clayton 5. SECRETARY, H. C. Sharp, 4060 W. Pine Blvd., St. Louis 8.

• **SHREVEPORT:** Organized 1948. Headquarters, Shreveport, La. Meets, Third Thursday. PRESIDENT, B. E. Segall, Jr., 603 Cotton St., Shreveport. SECRETARY, R. M. Hood, 411 Louisiana Ave., Shreveport.

• **SOUTH TEXAS:** Organized 1938. Headquarters, Houston, Tex. Meets, Third Friday. PRESIDENT, R. J. Salinger, 4510 Dewberry Lane, Houston 4. SECRETARY, G. J. Collins, P.O. Box 2463, Houston.

• **SOUTHERN CALIFORNIA:** Organized 1930. Headquarters, Los Angeles, Calif. Meets, Third Wednesday. PRESIDENT, J. L. Blake, 1700 S. Bedford St., Los Angeles 35. SECRETARY, M. C. Greiner, 1559 Club View Dr., Los Angeles 24.

• **SOUTHWEST TEXAS:** Organized 1946. Headquarters, San Antonio, Tex. Meets, Third Tuesday. PRESIDENT, L. S. Pawkett, 816 Insurance Bldg., San Antonio 5. SECRETARY, W. E. Long, Mechanical Engineering Dept., University of Texas, Austin.

• **UTAH:** Organized 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. President, C. E. Ferguson, 838 E. Garfield Ave., Salt Lake City. Secretary, A. R. Curtis, 2211 Highland Dr., Salt Lake City.

• **VIRGINIA:** Organized 1946. Headquarters, Norfolk, Va. Meets Third Wednesday PRESIDENT, W. P. Robinson, 1442 Ocean View Ave., Norfolk 3. SECRETARY, D. E. Phillips, P.O. Box 674, Newport News.

• **WASHINGTON, D. C.:** Organized 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. President, P. R. Achenbach, Connecticut & Van Ness St., Washington, D. C. Secretary, J. G. Muirheid, 2013 New Hampshire Ave., N. W., Washington 9.

• **WESTERN MICHIGAN:** Organized 1931. Headquarters, Grand Rapids, Mich. Meets, Second Monday. PRESIDENT, J. A. Alexander, P.O. Box 132, Station C, Grand Rapids. SECRETARY, L. A. Calcaterra, 1136-42 Plainfield Ave., N.E., Grand Rapids.

• **WESTERN NEW YORK:** Organized 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. PRESIDENT, F. J. Weber, 443 Delaware Ave., Buffalo 2. SECRETARY, J. M. Quackenbush, 610 Linwood Ave., Buffalo.

• **WISCONSIN:** Organized 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. PRESIDENT, B. M. Kluge, 1817 So. 66th St., Milwaukee 14. SECRETARY, J. A. Lofte, 2505 N. 97th St., Wauwatosa, 13.

### Student Branches

• **COLLEGE OF CITY OF NEW YORK:** Organized 1949. Headquarters, New York, N. Y. PRESIDENT, Norman Moskowitz, 153 Clinton Ave., Brooklyn 5. SECRETARY, Seymour Oestreicher, 2009 Bryant Ave., New York 60.

• **LOUISIANA POLYTECHNIC INSTITUTE:** Organized 1949. Headquarters, Ruston, La. PRESIDENT, C. W. Gorton, 301 S. Trenton, Ruston. SECRETARY, A. L. Jones, Jr., Apt. 40, Vetville, La. Tech. Station, Ruston.

• **NORTH CAROLINA STATE COLLEGE:** Organized 1948. Headquarters, Raleigh, N. C. PRESIDENT, J. J. Andrews, 710 Harvey St., Raleigh. SECRETARY, E. A. Stroupe, Jr., 416 Halifax St., Raleigh.

• **OKLAHOMA A. & M. COLLEGE:** Organized 1950. Headquarters, Stillwater, Okla. PRESIDENT, R. E. Metzkier, 14-E Midi, Box 563, Veterans Village, Stillwater. SECRETARY, W. D. Jenkins, 801 W. Walnut, Enid.

• **OREGON STATE COLLEGE:** Organized 1949. Headquarters, Corvallis, Ore. Meets, First Wednesday after First Tuesday. PRESIDENT, M. B. Larson, 2311 N. E. Hancock, Portland 12. SECRETARY, Helen P. Lankow, 1349 S. E. Birch St., Portland 14.

• **PURDUE UNIVERSITY:** Organized 1948. Headquarters, W. Lafayette, Ind. CHAIRMAN, D. M. Williams, c/o W. T. Miller, Mechanical Engineering Bldg., Purdue University, W. Lafayette. SECRETARY, J. D. Tuttle, 359 Northwestern Ave., W. Lafayette.

• **TEXAS A. & M. COLLEGE:** Organized 1946. Headquarters, College Station, Tex. Meets, Second and Fourth Tuesday. PRESIDENT, John E. Schumann, Texas A. & M. College, General Delivery, College Station, Tex. SECRETARY, A. G. Seelke, Jr., Box 4251, College Station.

• **UNIVERSITY OF DETROIT:** Organized 1949. Headquarters, Detroit, Mich. Meets First Tuesday. PRESIDENT, L. M. Blanchette, 2245 Holcomb, Detroit 14. SECRETARY, S. H. Kosinski, 4439-30th, Detroit 10.

• **UNIVERSITY OF KANSAS:** Organized 1949. Headquarters, Lawrence, Kans. PRESIDENT, J. L. Williams, 5278 Central, Kansas City, Mo. SECRETARY, R. C. Umholtz, 2732 Michigan St., Topeka, Kans.

• **UNIVERSITY OF TEXAS:** Organized 1949. Headquarters, Austin, Tex. Meets, First and Third Tuesday. PRESIDENT, L. T. Davis, 4409 Avenue C., Austin. SECRETARY, A. G. Allen, 1537B, Brackenridge Apts., Austin.

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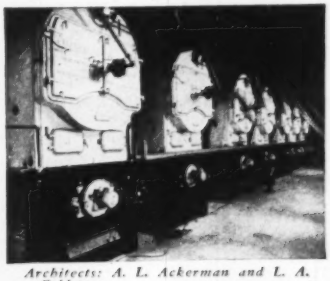

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**FITZGIBBONS STEEL BOILERS** are being installed to heat many of the huge building projects developed under the direction of the New York City Housing Authority. The selection of Fitzgibbons boilers for the Lillian Wald Project, illustrated above is significant, since operating economy and long life as well as comfort are major factors in planning these buildings.

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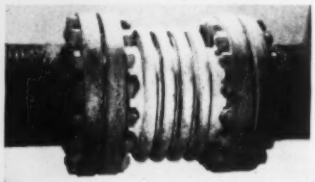
# Zallea Expansion Joint News

PUBLISHED BY ZALLEA BROTHERS—WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

**Expansion Joint of the Month**

## WHEN THE "HEAT'S ON"

Over six years ago a large oil refinery installed 39 non-equalizing expansion joints in its reactor piping. Within six months these joints failed . . . unable to withstand the terrific punishment of 1125° F. vapor temperatures. These were replaced by Zallea Expansion Joints. Today, over 5½ years later, these Zallea Expansion Joints, one of which is shown here in an unretouched photo, are giving trouble-free performance. Actually, both joints look alike . . . same alloy steel, same physical appearance.



But that's where similarity ends. The difference lies in the *control* exercised in every step of the manufacturing process of Zallea Expansion Joints. It's that *control* that makes Zallea the ideal joint for absorbing contraction and expansion of pipe lines due to temperature changes. Be *sure* of trouble-free operation in *your* plant . . . always specify ZALLEA.

. . . a complete, practical catalog on all Zallea Expansion Joints. A text book and a valuable reference source. Send for your *free* copy *today!*

ZALLEA BROTHERS, 816 Locust Street
Wilmington 99, Delaware

# Why Zallea Joints Last Longer

## CONTROLLED WELDING ASSURES LONGER EXPANSION JOINT LIFE

In a corrugated expansion joint, the deflection stress varies directly as the bellows thickness. And, the life of a corrugated expansion joint varies as the cube of the bellows thickness. Therefore it is essential that the corrugated bellows have a uniform thickness throughout. Only in Zallea Stainless Steel Expansion Joints are you assured of this optimum condition because Zallea alone produces a longitudinal weld of the same thickness as the parent metal.

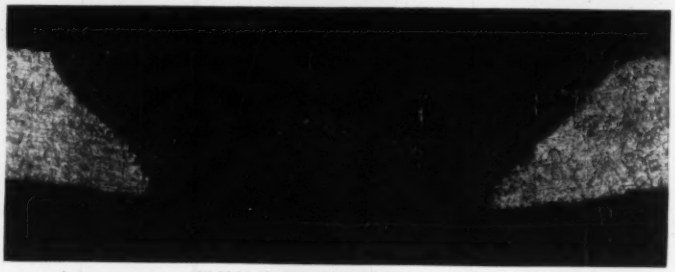
### *Welding Methods Tested*

Accelerated flexing tests of corrugated bellows proved that the resultant welding bead of a shielded arc weld was detrimental to the life of the bellows because failure always occurred across the weld —thickest section of the bellows. Zallea metallurgists, after analyzing the many known welding processes, found that by adopting an exclusive variation of the Heliarc process and adding a grain refining procedure to the finished weld, they could produce a corrugated bellows that under accelerated flexing tests *failed in the parent metal only.*

### *Longer Life Assured*

In over 100 bellows tested with Zallea *controlled* welding, not one failure occurred within 30 degrees of the weld line. More important was the fact that these bellows lasted four to eight times longer than bellows having a shielded arc welding bead. The two unretouched photomacrographs below illustrate the exclusive Zallea *controlled* welding technique as compared to the welding procedure used in other expansion joints. When you want the best in stainless steel expansion joints, always specify ZALLEA . . . you'll find it pays!

**Weld bead of Zallea Expansion Joints (Compare fine grain of weld with illustration below)**



**Weld bead of competitive expansion joint**

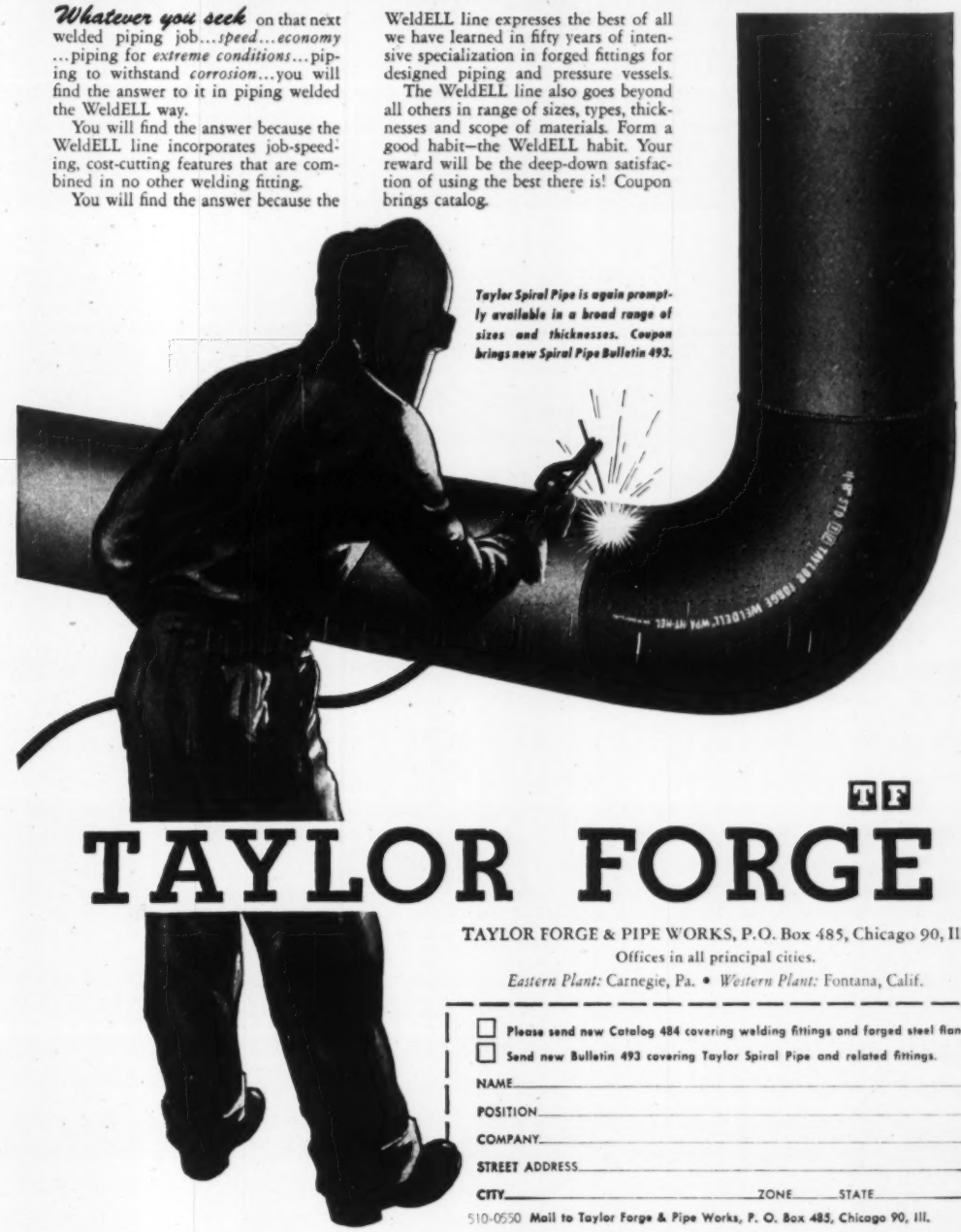
# WeldELLS®

***Whatever you seek*** on that next welded piping job...*speed*...*economy*...piping for *extreme conditions*...piping to withstand *corrosion*...you will find the answer to it in piping welded the WeldELL way.

You will find the answer because the WeldELL line incorporates job-speeding, cost-cutting features that are combined in no other welding fitting.

You will find the answer because the WeldELL line expresses the best of all we have learned in fifty years of intensive specialization in forged fittings for designed piping and pressure vessels.

The WeldELL line also goes beyond all others in range of sizes, types, thicknesses and scope of materials. Form a good habit—the WeldELL habit. Your reward will be the deep-down satisfaction of using the best there is! Coupon brings catalog.



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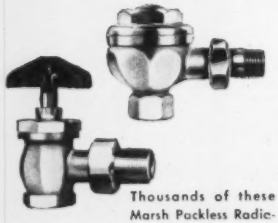
# Thousands of Marsh Valves and Traps *in this big project alone*

Just a part of the big Marcy project of the New York Housing Authority is shown in the photograph above. Buildings like these are planned with an eye on minimized maintenance and operating costs; so it is significant that Marsh equipment was chosen here for the vital spots in the steam distribution system.

In the Marcy project alone, Marsh Radiator Valves and Traps running into many thousands were installed; and it is only one of a large number of developments of this kind in which Marsh packless radiator valves, radiator traps, float and thermostatic traps, air vents, strainers and other equipment was accorded the preference.

But significant though they are, these big housing projects are only one more example of large-scale heating systems in outstanding buildings all over America in which Marsh heating equipment has rated the first choice of foremost heating engineers and contractors.

For that next job use Marsh equipment. You will see in its advanced design and quality construction why Marsh is the first choice of the most critical heating men.



Thousands of these Marsh Packless Radiator Valves and Traps went into the Marcy housing project. In the Marsh metal-to-metal seal you have the finest packless valve construction and in the Marsh radiator trap you have the most dependable, most efficient trap for all of your two-pipe systems.

This Marsh No. 8 float and Thermostatic Trap is typical of more than 300 like traps used in the Marcy project alone. Other types included the Marsh No. 12, No. 14, No. 140. More than 200 Marsh Strainers were also used.

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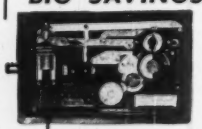

By controlling heat in accordance with outside weather, Marsh Tritrol gives maximum comfort with minimum heating cost. Installation is simple; cost is low. Ask for facts.

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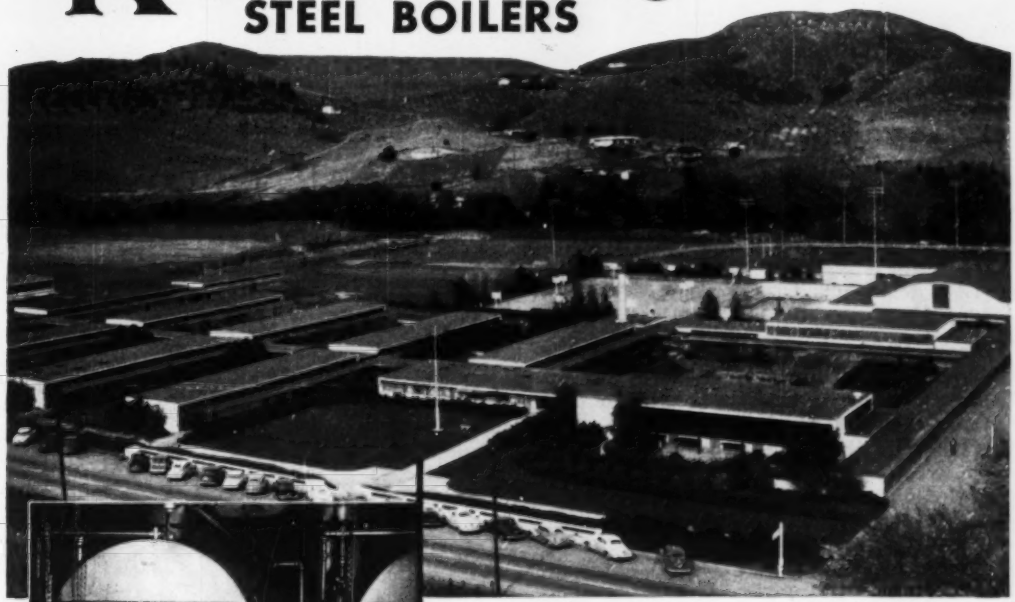
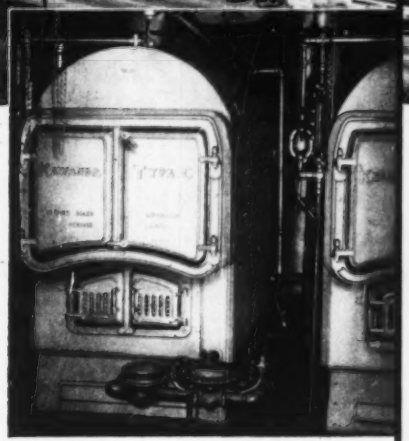
# KEWANEE
## STEEL BOILERS





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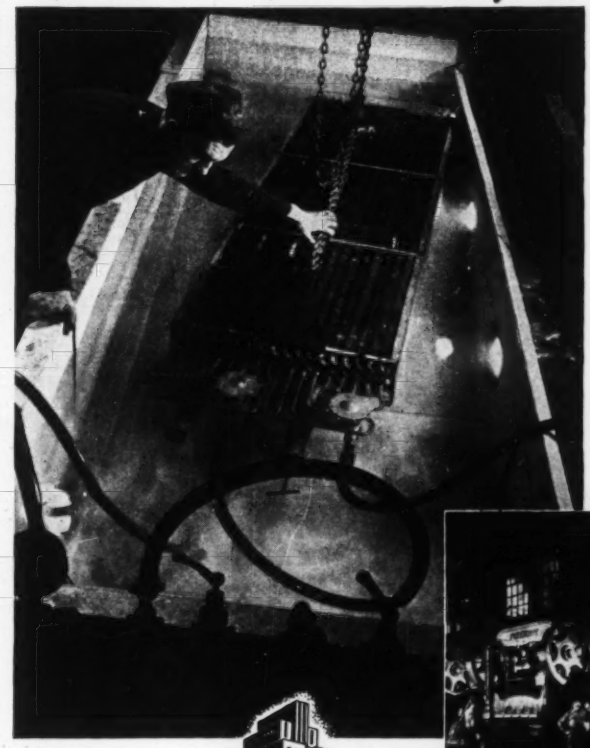

This man is completing one of the many tests used to control the quality of Aerofin finned heat-transfer surface. He is looking for air bubbles in a specially illuminated tank. If there are no bubbles, it means the immersed Aerofin unit has withstood the terrific strains of steam and hydrostatic pressure tests and is ready to give you long, efficient service.

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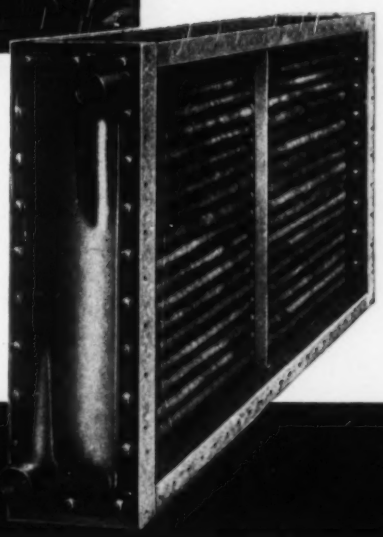
Aerofin is devoted exclusively to the production of finned heat-transfer surface. This specialization enables Aerofin engineers to select just the right surface and materials for the job, enables expert workmen to assemble these materials into a highly efficient unit.



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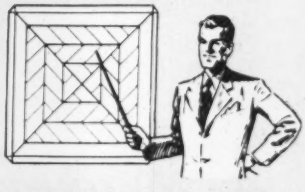
AIR DIFFUSERS • AIR FILTERS • ROOF EXHAUSTERS

***Here's the Secret of Greater Diffusing Ability:***



Patented built-in vanes deflect the air in numerous divergent streams resulting in turbulence at the point of contact with the aspirated air. Result: Rapid mixing, diffusion and temperature equalization.

THE DIFFUSING VANES MAKE THE DIFFERENCE

# look-no hands!

## this is your heating superintendent when you heat with Dravo Heaters

It's an *automatic* fireman who goes on the job at the flip of a switch for the Sanatex Company of Chicago. It cuts operational and maintenance expense to the bone and solves what had appeared to be an expensive heating problem for this processor of wiping cloths.

Not only is an attendant unnecessary—boiler-room and ductwork expense was eliminated, too, by installation of a Dravo *Counterflo* Heater. Centered along the east wall, the Dravo *Counterflo* Heater is entirely self-contained—requiring only power and fuel lines and a small vent stack. Its 1,000,000 BTU output is directed slightly over the heads of the workers to blanket 10,000 square feet of unbroken plant area with draft-free warm air. Cold corners and excessive roof heat loss are eliminated. During summer months, a touch of the selector switch converts the Dravo *Counterflo* Heater immediately into a powerful air-circulating unit.

Dravo *Counterflo* Heaters are available in sizes ranging from 400,000 to 2,000,000 BTU output. Equally efficient with oil or gas and with or without ductwork, they can be floor-installed, wall-hung or roof-hung. Write for Bulletin LM-523. Heating Section, Dravo Corporation, Dravo Building, Pittsburgh 22, Pennsylvania.

According to Mr. Schulman, President of Sanatex Company, the Dravo *Counterflo* Heater "is the best equipment we ever had. Delivery of heat is virtually instantaneous when the unit goes into action—an important fuel-saving feature which eliminates the need for anticipating cold spells or keeping the heater in operation when the plant is closed."

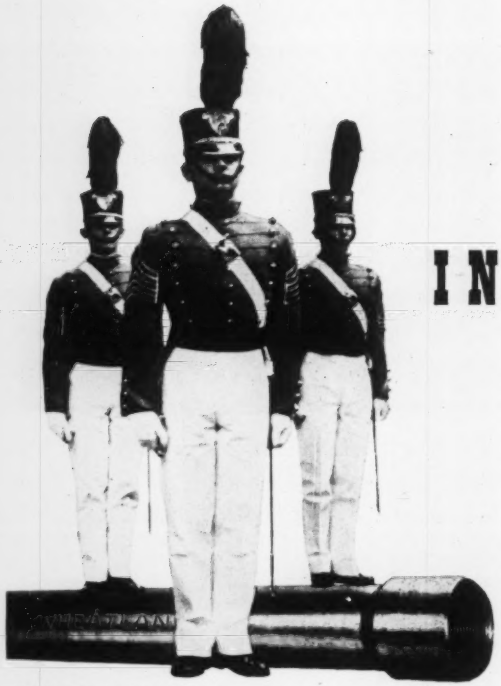
PITTSBURGH · CLEVELAND
PHILADELPHIA · DETROIT
NEW YORK · CHICAGO
ATLANTA · BOSTON

DRAVO

Dravo also manufactures the *DRAVO CRANE CAB COOLER* for air conditioning hot-metal crane cabs.

**DRAVO CORPORATION**

*Sales Representatives in Principal Cities*



Official United States Army Photographs

# INSPECTION

*Regular, rigid inspection accounts for the parade ground perfection of West Pointers.*

*Regular, rigid inspection accounts for the perfection of Wheatland Steel Pipe.*

*Experts thoroughly familiar with steel technology and piping problems constantly put our products through exhaustive testing. This is a basic Wheatland policy adopted to insure the complete satisfaction and protection of our users.*

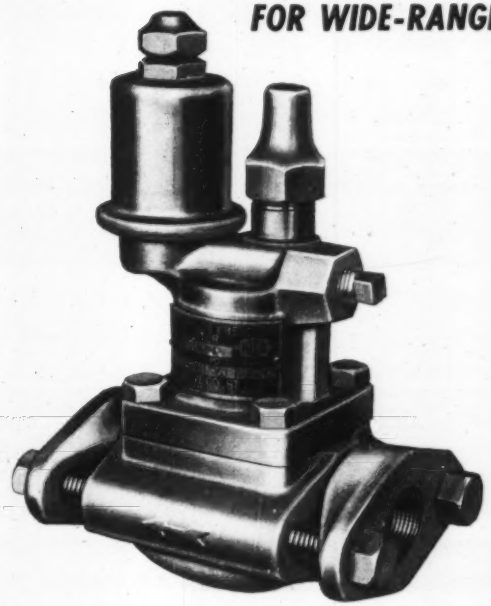
*-pipe with the yearmark!*

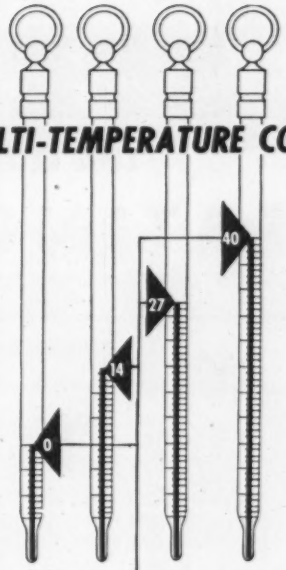
**WHEATLAND TUBE COMPANY**

**BANKERS SECURITIES BUILDING · JUNIPER AND WALNUT STREETS · PHILADELPHIA 7, PA.**

# ALCO EVAPORATOR PRESSURE REGULATOR VALVES

## FOR WIDE-RANGE MULTI-TEMPERATURE CONTROL






**FOUR REASONS WHY YOU'LL GET *BETTER RESULTS* WITH ALCO EPR VALVES:**

- Rugged, corrosion-resistant, simple come-apart construction for longer life and easier servicing.
- Precision-balanced to operate on minimum pressure differential.
- Pilot-operated for greater sensitivity. Available with either pressure or temperature pilots, remote or integral.
- They accurately maintain evaporator pressure and temperature regardless of sudden changes in load.

You can rely *completely* on ALCO EPR Valves to maintain a minimum evaporator pressure in cold storage rooms where pressure must be accurately controlled—or to prevent freeze-up damage to shell and tube coolers.

When you specify ALCO, all the 25 years' experience of the industry's leading control manufacturer is built into each Alco Valve.

SEE YOUR ALCO WHOLESALER

25 YEARS

A QUARTER-CENTURY OF PIONEERING AND PROGRESS

**ALCO VALVE CO.**

861 KINGSLAND AVE. • ST. LOUIS 5, MO.

Designers and Manufacturers of Thermostatic Expansion Valves, Evaporator Pressure Regulators, Solenoid Valves, Float Valves, Float Switches

*ALCO HAS REFRIGERATION UNDER CONTROL*

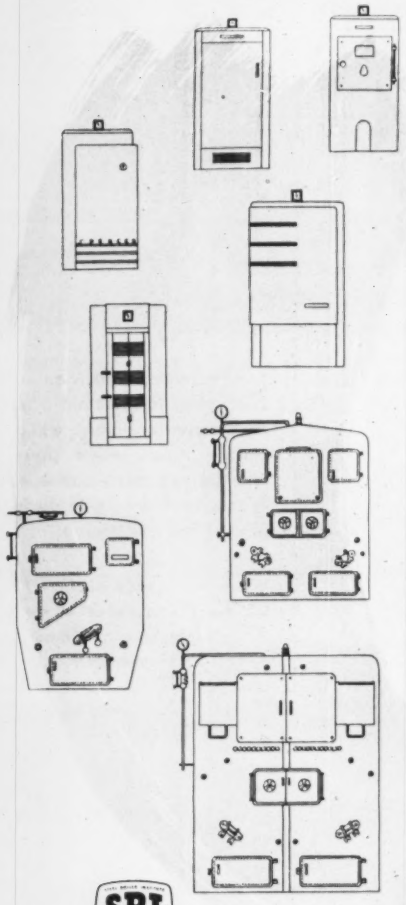
4353

# SPENCER

## THE QUALITY LINE OF

# HEATING BOILERS

**BACKED BY MORE THAN 60 YEARS' LEADERSHIP**



**VERSATILE:**

Boilers for all types of fuel, all methods of firing, all sizes of installations

**DEPENDABLE:**

Precision-engineered and manufactured to give superior, *guaranteed* service

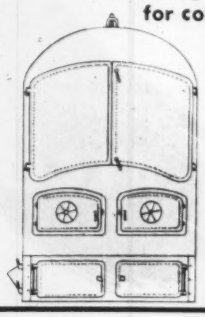
**THERE IS A**

# SPENCER

**FOR *EVERY* BUILDING . . .**

**FOR *EVERY* FUEL**

**Including 34 Steel Heating Boilers for commercial installations**



SBI

H

I B R

Constructed in accordance with ASME requirements. Fully approved by Steel Boiler Institute or Institute of Boiler and Radiator Manufacturers.

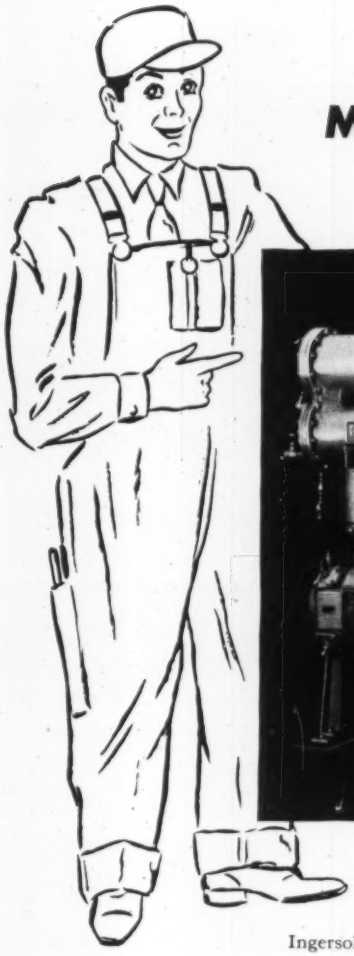
**SPENCER HEATER**

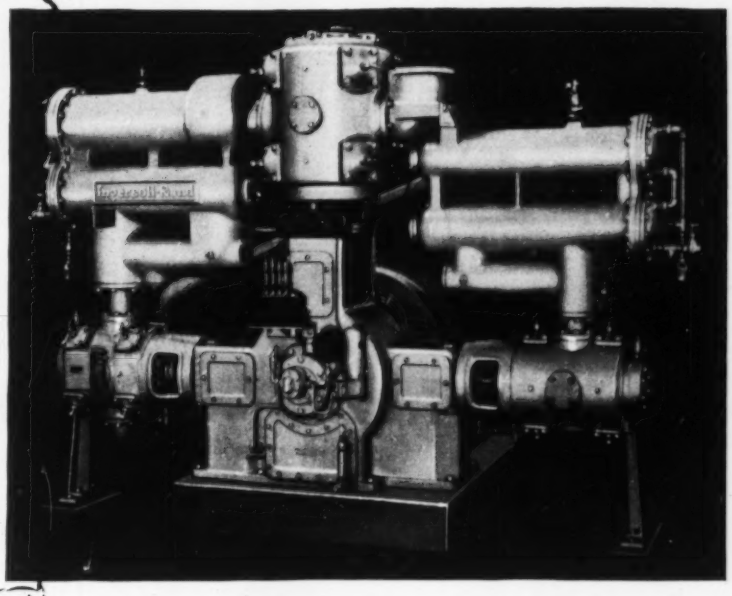
LYCOMING-SPENCER DIVISION

WILLIAMSPORT lyco PENNSYLVANIA

**Write for free catalogue today**

# MASTER OF MANY TRADES





## bearings engineered by SKF

Ingersoll-Rand's 3-stage TVH Heavy-duty Compressors are widely used for boiler soot-blowing service, for handling gases where leakage must be avoided, for compressing air in oxygen production, and in scores of other applications. They're compact, highly efficient, give long-life heavy-duty service. The two main bearings are SKF Double-Row Self-Aligning Spherical Roller Bearings. They require no adjustment . . . are engineered and built to withstand heavy radial and thrust loads. SKF specializes in supplying the bearing that's right for the job . . . the bearing that keeps friction at a minimum and makes important contributions to long-term trouble-free operation. SKF Engineers will work with you in helping you design for greater efficiency and lower operating costs. **SKF** INDUSTRIES, INC., PHILADELPHIA 32, PA., *the Pioneers of the Deep Groove Ball Bearing – Spherical Roller Bearing – Self-Aligning Ball Bearing.*

7105

SKF

BALL AND ROLLER BEARINGS

8 REASONS WHY SKF IS PREFERRED BY ALL INDUSTRY

Integrity — Craftsmanship — Metallurgy — Tolerance Control

Surface Finish — Product Uniformity — Engineering Service — Field Service

York Refrigeration Unit with an Allen-Bradley Bulletin 709 Solenoid Starter.

york refrigeration air-conditioning

# REFRIGERATION UNITS

*equipped with*

A-B Quality

# Trouble Free Motor Controls

Bulletin 709, Size 1 Solenoid Starter. Compact, simple, and trouble free. Ample wiring space.

**WHY ARE ALLEN-BRADLEY STARTERS SO POPULAR** for air-conditioning service? . . . Because they are trouble free. Only one moving part. No pivots, pins, or bearings to corrode or stick . . . no jumpers to break. You install them . . . and forget them!

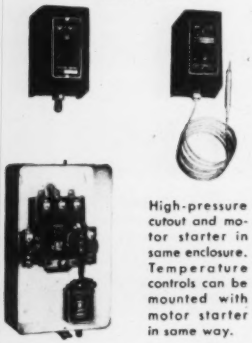
**NO CONTACT MAINTENANCE.** Allen-Bradley patented silver alloy contacts never need cleaning, filing, or dressing.

**DEPENDABLE OVERLOAD RELAYS.** Allen-Bradley thermal relays are accurate and dependable even after long service.

The A-B trademark stands for millions of trouble free operations. Allen-Bradley Co., 1335 S. First St., Milwaukee 4, Wisconsin.

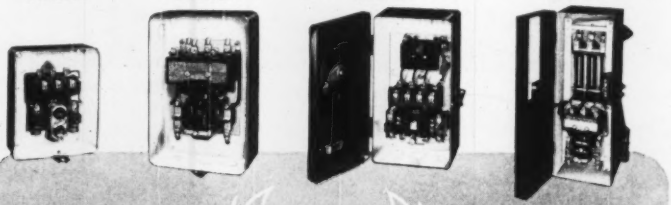
## ALLEN-BRADLEY AIR-CONDITIONING AND REFRIGERATION CONTROLS

**PRESSURE AND TEMPERATURE CONTROLS**



High-pressure cutout and motor starter in same enclosure. Temperature controls can be mounted with motor starter in same way.

**MANUAL STARTER** | **AUTOMATIC STARTER** | **COMBINATION STARTER** | **HEAVY COMPRESSION STARTER**

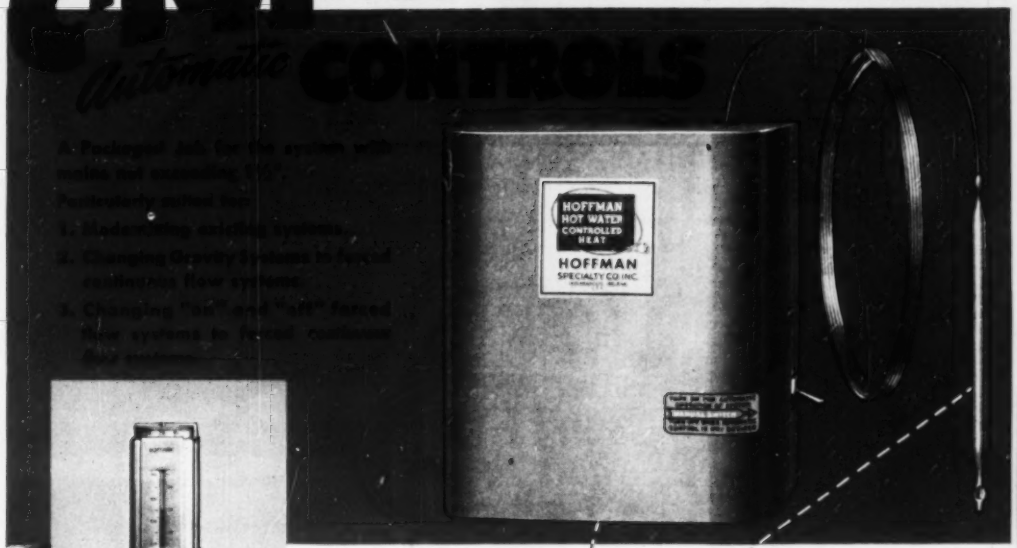


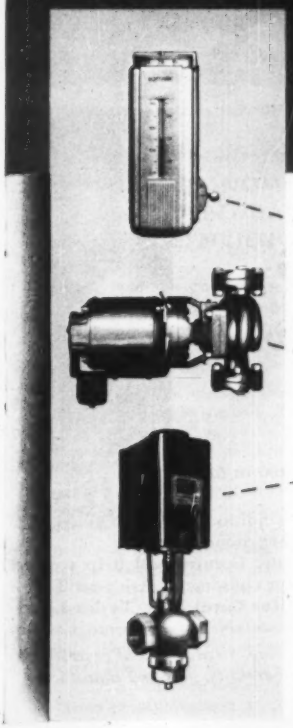
**ALLEN-BRADLEY**

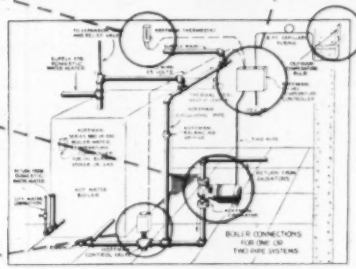
**SOLENOID MOTOR CONTROL**

# C-141 HOT WATER SYSTEM

## Automatic CONTROLS






HOFFMAN C-141 CONTROLLER: Automatically maintains indoor comfort and temperature by combining Room Thermostat control with continuous circulation of the heating medium.

HOFFMAN CIRCULATOR: Continuously circulates the heating medium throughout the heating season. Automatically stops when outdoor temperature goes above 65° and starts again in the fall when heat is required.

HOFFMAN CONTROL VALVE: An especially designed valve to keep the hot water in the heating system at the desired temperature to maintain heating comfort.

HOFFMAN BALANCING ORIFICE: Engineered to maintain proper balance between the circulating pipe and boiler circuit.

HOFFMAN ROOM THERMOSTAT: Heat anticipating thermostat adjustable to slow, medium and fast cycles.

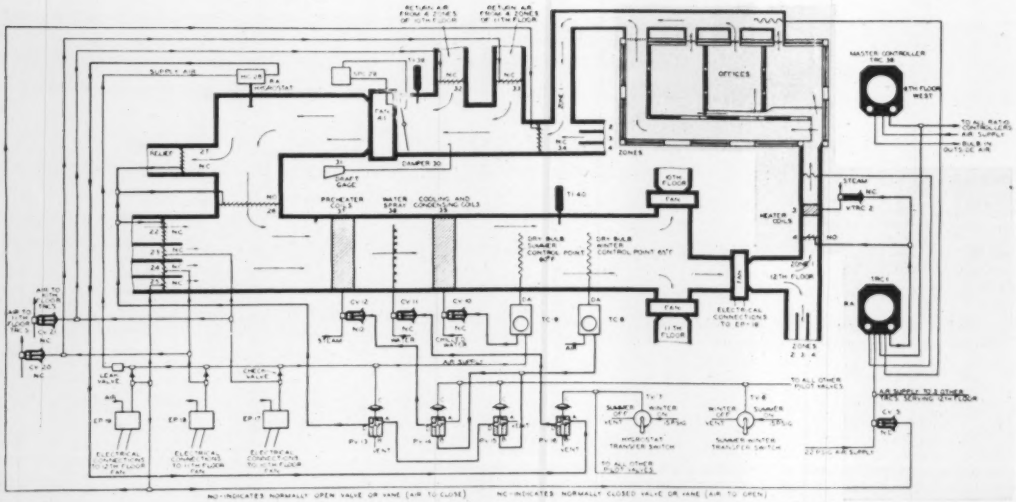
### A POPULAR PRICED CONTINUOUS CIRCULATION SYSTEM..... *THERMOSTATICALLY CONTROLLED*

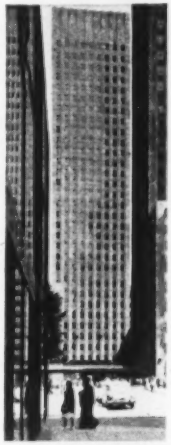
The Hoffman C-141 Comfort Package offers *precisely controlled heating*—yet the cost is within the budget of even modest homes.

The uniformity of a *continuously circulated* forced hot water heating system can now be obtained with simplified and inexpensive equipment. The Hoffman C-141 Comfort Package combines a Circulating Pump, Temperature Controller, Control Valve and Room Thermostat.

In operation, the C-141 Comfort Package effects a constant balance between heat loss and heat supply, so that the home temperature is held uniform, regardless of weather variations. Note in the diagram that the boiler is by-passed from the rest of the circulating system. Hot water from the boiler is admitted *only* when the room thermostat requires additional heat. Hence the system keeps pace with the actual need for heat and never delivers a fuel-wasting excess. Send for Bulletin No. HW-647.

# HOFFMAN *Hot Water* CONTROLS





# 33 STORIES OF AIR CONDITIONING

## *run by Taylor "Brains"*

**THE NEW ESSO BUILDING** at Rockefeller Center is kept comfortable 12 months a year with a Taylor-controlled air conditioning system—one of the largest and most efficient ever installed. Buensod-Stacey, Engineering Contractors, installed this system which was designed by Pollack and Grieve, Consulting Engineers.

Above is a typical control center and one of the 12 control zones (shaded area) of the three floors which it serves. The Taylor Ratio Controller for each zone (lower right) increases or decreases temperature of incoming air according to demand for that zone. All 169 zone Ratio Controllers are reset automatically by the Master Fulscope* Temperature Controller (top right) so that as outdoor temperature increases, indoor temperature is automatically increased in a pre-determined ratio. The system dehumidifies and cools the building in Summer; humidifies and heats it in Winter. Master Seasonal Transfer Switches on main control panel in sub-basement give the operating engineer automatic control of all these functions for the 500,000 cubic feet of air circulated in the building *every minute.*

Whether you need air conditioning for human comfort or product quality, Taylor Automatic Control will help you get top efficiency out of your equipment. Ask your Taylor Field Engineer! **Write for Catalog 5.** Taylor Instrument Companies, Rochester, N.Y., or Toronto, Canada.

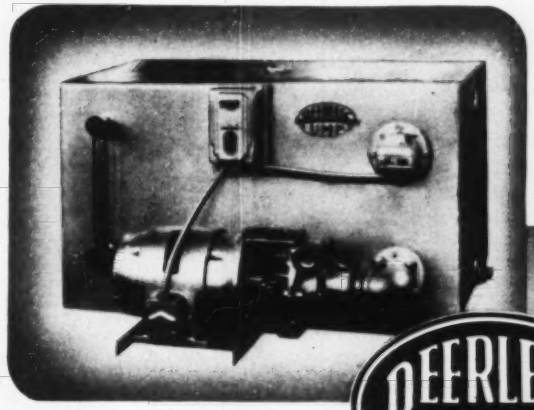
*Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.*

*Registered Trade-Mark

**Taylor Instruments**
**MEAN**
**ACCURACY FIRST**
**IN HOME AND INDUSTRY**

# LOOK TO THE LEADER—LOOK TO PEERLESS

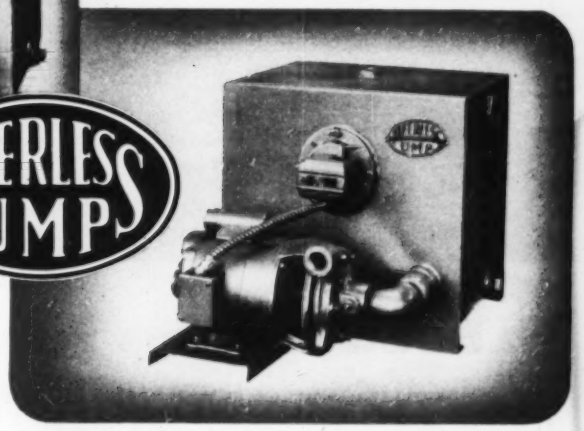
## FOR ECONOMICAL CONDENSATE RETURN UNITS



SIMPLEX INTEGRAL H.P. UNIT

**SIMPLEX AND DUPLEX UNITS FOR CAPACITY RANGE OF 1000 TO 100,000 EDR**
***PRESSURES:* 20, 30, 40 LBS.**

PEERLESS PUMPS



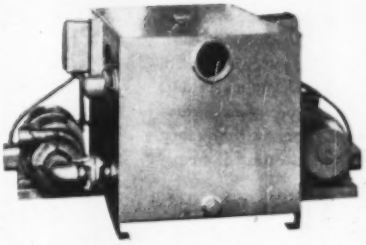
SIMPLEX FRACTIONAL H.P. UNIT

*Featuring day-after-day*
**PEERLESS ECONOMY**
**PEERLESS DEPENDABILITY**
**PEERLESS EFFICIENCY**

**QUALITY AT LOW COST**—When you buy condensate return units you can get both highest quality and low cost by insisting on Type PC Peerless units, made by the manufacturer of famous Peerless Pumps.

Peerless quality is quickly evident throughout these condensate receiver units. The pumps that power these units are close-coupled, bronze fitted vertically split case design, proved by Peerless in thousands of installations. Refinements in design for pumps of this type include the use of stainless steel shaft and a positive-action mechanical shaft seal on all units from ½ to 1 h.p. inclusive. Receiver tanks are constructed of heavy gauge, copper bearing steel, accurately welded and pressure tested. No special base plate or foundation is required. Air circulating space is provided between floor and receiver tank, helping to eliminate corrosion due to wet floors. Float switch is highest quality and adjustment within moderate limits is possible without removal from unit. Single phase motors are capacitor type rated at 115/230 volts, with built-in overload protection on ½-1 h.p. sizes. Three phase, single voltage motors are also available. Magnetic starter is supplied on all single phase units 1½ h.p. and larger and on all 3 phase units.

All Peerless condensate units are furnished complete ready for service. If you want quality



DUPLEX INTEGRAL H.P. UNIT

with economy and dependability of performance, day by day, over the years, specify and buy Peerless Type PC Condensate Return units. Peerless distributors are located in all principal cities for service and engineering help. A descriptive Bulletin, complete with rating tables and full specifications on all models is available upon request. Write today for Bulletin B-2201.

*Specifications*

**SIMPLEX UNITS**

⅓ and ¾ h.p. at 20 and 30 lbs. discharge pressure with capacity rating of 1,000-10,000 EDR
Receiver Capacity: 16 gallons

**SIMPLEX AND DUPLEX UNITS**

½-5 h.p. at 20, 30 and 40 lbs. discharge pressure with capacity rating of 10,000-100,000 EDR
Receiver Capacities: 30-98 gallons

PEERLESS PUMPS fmc

**PEERLESS PUMP DIVISION**
**FOOD MACHINERY AND CHEMICAL CORPORATION**
Factories: Los Angeles, California, and Indianapolis, Indiana
Offices: New York, Atlanta, Fresno, Los Angeles, Chicago, St. Louis, Phoenix, Dallas, Planview and Lubbock, Texas

# Budd chooses Air-Maze filters for new rail diesel car!

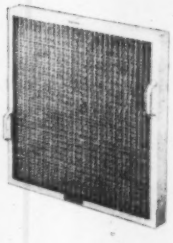
FOR extra passenger comfort, Air-Maze filters in the ventilating system of Budd's new RDC's keep the air clean and free from dust and lint.

Air-Maze special railroad filters are of rugged, all-metal construction and provide the extra dust holding capacity so essential to heavy duty service. Because they hold more dust, the frequency of servicing is cut. And when cleaning is necessary, it's quick and easy.

For twenty-five years, Air-Maze filters have been proving themselves in all types of transportation and industrial applications. The filters used in the Budd RDC's are only two of many types of special Air-Maze railroad filters which are widely accepted in passenger car, diesel engine and diesel cab applications. For help in your air filter problem, contact your nearby Air-Maze representative or write the Air-Maze Corporation, 5200 Harvard Avenue, Cleveland 5, Ohio.

**TYPE P-18**
**FOR FRESH AIR INTAKE**

A special 4"-thick filter. All metal, low resistance. Holds more dirt than other designs. Requires less servicing.



**TYPE B**
**FOR RECIRCULATED AIR**

Progressively graduated density of the media (galvanized steel wire cloth) permits collection of lint and other fibrous material with low pressure drop rise.

AIR FILTERS
SILENCERS
SPARK ARRESTERS

**AIR-MAZE**
**THE FILTER ENGINEERS**

LIQUID FILTERS
OIL SEPARATORS
GREASE FILTERS

# AMERICAN-Standard

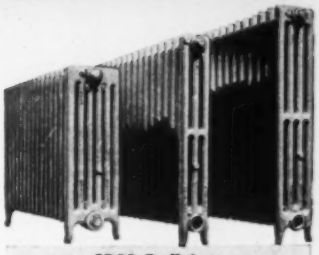
**First in heating . . . first in plumbing**

# *Quality Radiators*

## For Every Type and Size of Job!

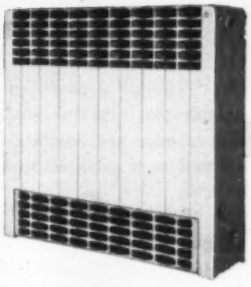
ONE of the most important advantages in handling American-Standard Heating Equipment is that *it is a complete line*—including boilers for all fuels and, in addition, giving you the widest range of radiators. So when a prospective client says he's interested in one, you have an opportunity to install both. And, by so doing, you put yourself in better position to promise him *complete heating satisfaction!*

American-Standard radiators and convectors, in styles and sizes for every type of installation, are sold through selected Wholesale Distributors to Heating and Plumbing Contractors. **American Radiator & Standard Sanitary Corporation**, P. O. Box 1226, Pittsburgh 30, Pennsylvania.



**ARCO Radiators**

The thin-tubed radiator that does a big heating job. Slender, modern, graceful, they deliver as much heat as old-style radiators 1/5 larger. Made in 4 widths and several heights to meet all needs.

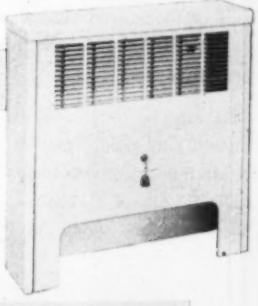


**SUNRAD Radiator**

Made of durable cast iron. Provides both radiant and convected heat. Its smart, simple lines make it an ideal unit for all types of residential or commercial buildings. Can be installed recessed, semi-recessed or free-standing.

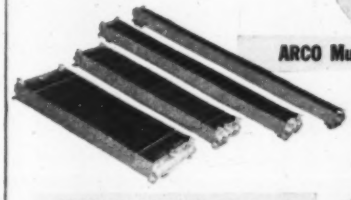
**ARCO Multifin Convector (stock model)**

Consisting of the famous Arco Multifin Convector in combination with the smartly-styled NFS Enclosure, these stock models are completely assembled in one package as a single, compact unit. Available in sizes for which there is the greatest demand—in heights of 20, 24 and 32 inches; and in widths 6¼, 8¼ and 11½ inches and in ten lengths—from 21⅛ to 65⅛ inches.



**ARCO Multifin Convectors**

Made for all systems except one-pipe steam. Convector elements have ¾" diameter seamless copper tubes, correctly spaced nonferrous fins, cast iron headers and protective steel side plates.

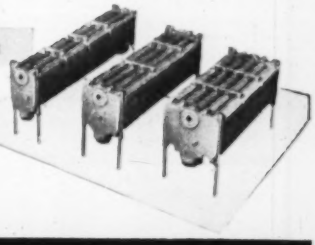


**BASEBOARD RADIANT PANELS**

Installed at the floor line, replacing ordinary baseboards, they take up little more than an inch of floor space when recessed. Made of cast iron, panels come in two types as illustrated above. Type R, at left, provides radiant heat alone. Type RC combines both radiant and convected heat for use where heating requirements are above average. Can be used with forced hot water or two-pipe steam system.

**ARCO Cast Iron Convectors**

Scientifically engineered and rated by the American-Standard Institute of Heating Research, Arco Cast Iron Convectors provide a continuous flow of warmed air, resulting in quick and economical heating. May be installed in attractive American Enclosures.



*Serving home and industry*

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

# How can I do a more effective job of Business Paper Advertising— *without using more money?*

TODAY many companies are faced with the need to promote new products and obtain more intensive market coverage without increasing advertising expense. And as usual Mother Necessity provides an answer—better media selection. In applying media to markets and coordinating advertising with sales plans, all investments should be made on the basis of verified circulation information in connection with dependable market data.

The facts by which the advertising value of publications may be judged are given in the reports issued by the Audit Bureau of Circulations. This cooperative and nonprofit association of 3300 advertisers, advertising agencies and publishers—

**1** **Has established standards, definitions and rules that make it possible to measure, evaluate and compare the paid circulations of published media.**

**2** **Maintains a staff of experienced and specially trained circulation auditors to audit the circulations of publisher members.**

**3** **Issues reports giving advertisers the factual information that is indispensable to economical and effective space buying.**

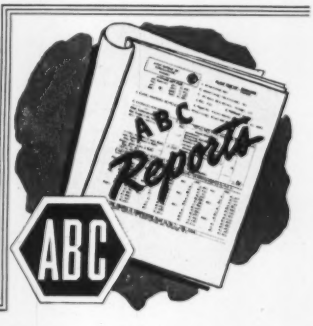
Included in the verified information in A.B.C. reports of business papers is a breakdown of the paid subscribers by occupation or kind of business. Thus advertisers know how much of the circulation goes to the specialized markets in which they are interested, can select media and write copy accordingly.

Other information in A.B.C. reports: How much paid circulation; how much unpaid; where the subscribers are located; what they pay for the publication; whether or not premiums are used; how many subscribers are in arrears; how many subscriptions are renewals.

It is only when media is selected on the basis of such factual information, as provided in A.B.C. reports, that advertisers can be sure of the greatest value for their advertising dollars. That is why this business paper is a member of the Audit Bureau of Circulations. Ask for a copy of our A.B.C. report and then study it.

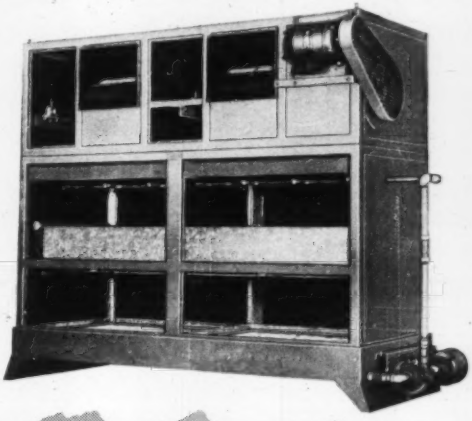
**SEND THE RIGHT MESSAGE TO THE RIGHT PEOPLE**

Paid subscriptions and renewals, as defined by A.B.C. standards, indicate a reader audience that has responded to a publication's editorial appeal. With the interests of readers thus identified, it becomes possible to reach specialized groups effectively with specialized advertising appeals.

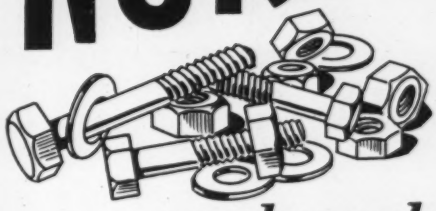



## Heating Piping & Air Conditioning

**A.B.C. REPORTS — FACTS AS THE BASIC MEASURE OF ADVERTISING VALUE**



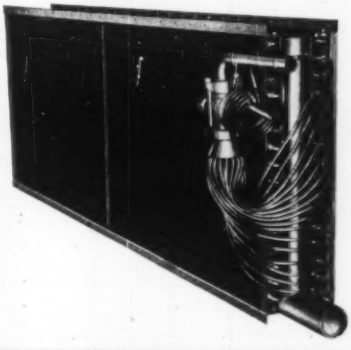
# NUTS!



## and good Bolts too!

KENNARD *Engineered*

**EVAPORATIVE CONDENSERS**
**AIR CONDITIONING UNITS**
**COOLING TOWERS**
**BLAST COOLING, HEATING, AND REFRIGERATION COILS**



NUTS, for instance—as well as all washers, bolts and metal screws are ***always*** **of non-corrosive** Stainless Steel or Silicon Bronze or Brass in all E C and C T Units. Even the coil frames have Silicon Bronze fasteners to bolt up the non-corrosive frame sections and tube sheets. Such "refinement of detail" insures that whenever you may need to take the unit apart—it can be done quickly, easily and without fighting and replacing corroded-together fasteners.

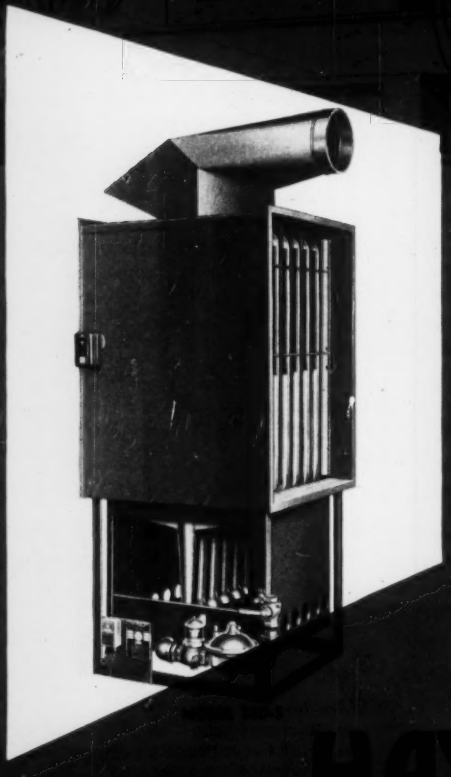
Yes, we DO go to extremes to make Kennard products as good as can be made to deliver *plus value* in low-cost and long-lived performance.

Other Kennard quality features you will like are non-corrosive coil frames, scale-free coils, sectional galvanized unit frames, Penta-Post construction, multiple access panels, solid bronze latches, etc. . . . an ensemble of quality construction that makes "KENNARD ENGINEERED" signify *the best!*

*"Refinement of Detail Marks the Difference Between Ordinary and Excellent."*

***Write for Bulletins...***
**No. 47A — FINNED COILS**
**No. 486 — AIR CONDITIONING BLOWER UNITS**
**No. 491 — EVAPORATIVE CONDENSERS**
**No. 494 — COOLING TOWERS**

**KENNARD CORPORATION** • **1817 S. HANLEY ROAD ST. LOUIS 17, MISSOURI**



**HAYES DUCT FURNACE SETS A NEW HIGH STANDARD FOR QUALITY . . .**

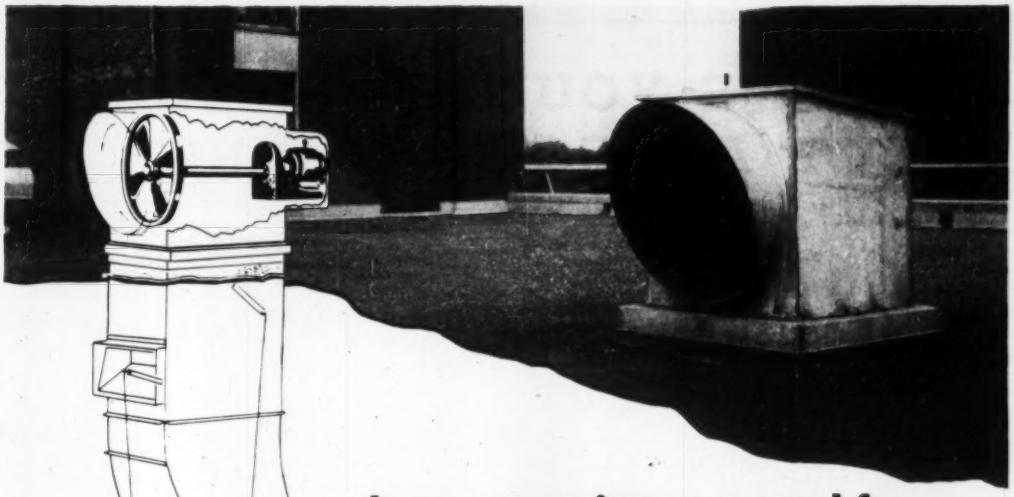
1. Designed to be used as a direct fired heat exchanger for Industrial-Commercial and Air-Conditioning systems.
2. Requires less floor space than any other direct fired unit of comparable capacity.
3. Reinforced stainless steel heat exchanger and all-welded construction assure long life.
4. Manufactured in 14 sizes to accommodate accurate BTU requirements.
5. Light weight compact design, saves space, labor, and shipping costs.
6. No need to protect heat exchanger with dampers when installed down stream of cooling coils, nor when condensation is possible.

For complete information and specifications write your nearest dealer or

**HAYES FURNACE MFG. & SUPPLY CO.**
2930 South Fairfax Ave., Los Angeles 16, Calif.

# HAYES DUCT FURNACE


[illegible] • BANCOR & CO., 320 Main Street, Atlanta, Georgia • BOOCOCK [illegible] CO., 1220 Columbia Street, Dubuque, Iowa • [illegible] CO., [illegible] CO., 200 Public Sq., Cleveland, Ohio • [illegible] SPECIALTY CO., 1116 Harper Ave., [illegible] • J. C. Davis, Hawaii Building, Little Rock, Arkansas • J. H. O'CONNOR CO., 1620 N. W. 39th, Oklahoma City, Oklahoma
REYD ENGINEERING CO., 16 South Third St., Phoenix, Arizona



# brewery engineers control fumes with PROPELLAIR fans

Alert maintenance engineers at the Hamm Brewing Company, St. Paul, use Propellair Fans to prevent caustic fumes escaping from their bottle-soaking machines. Knowing the harmful effect that condensation of this steaming solution could have on painted walls, Hamm engineers installed Propellair fans on the roof of the bottling house to create a negative pressure on the soaking machines. Propellair engineers recommended the most efficient designs and ratings. These effectively remove the vapors and keep temperatures down on hot summer days.

## efficient design

Camber of front and back surfaces produce push-pull action so that Propellair blades create maximum air movement. Blades are designed on the same principle as an airplane wing. Entire blade works, moves air.

## propellair is versatile

Propellair is adaptable to any situation. Cools men and machines. Removes dust, dirt, fumes. Saves money, ups efficiency.

Discuss your ventilating problems with experienced Propellair engineers. No obligation.

PROPELLAIR

DIVISION OF ROBBINS & MYERS, INC.

SPRINGFIELD 99 OHIO

# IMPROVE YOUR KNOWLEDGE OF AIR CONDITIONING

SEND TODAY FOR
Samuel R. Lewis'

## "AIR CONDITIONING FOR COMFORT"

288 Pages—6¼" x 9¼"—Illustrated—
Cloth Bound—$2.00

$2.00

Here is a book that presents—in simple, readily understandable form—every kind of information necessary for an accurate and thorough knowledge of air conditioning principles, equipment and practices. Written by S. R. Lewis, a widely-known consulting engineer who has been active in air conditioning work for more than thirty years, it deals with all angles of the air conditioning subject from the practicing engineer's viewpoint. The designing procedures explained in the book are, for example, in every detail the same procedures employed today by the author's own organization.

Featuring this third edition are chapters on phases of the subject not previously treated, including noise control, air conditioning measurements, air conditioning standards, fire protection codes and operating suggestions. Several complete examples of correct design procedure are given, together with forms for recording the design data, the proper filling-in of which are explained step-by-step.

The chapter devoted to Psychrometry presents nineteen different formulas for psychrometric calculations. In illustrating the correct use of these formulas, Mr. Lewis applies both the psychrometric tables and charts in order to render both devices thoroughly understandable.

### OF VALUE BOTH AS A REFERENCE AND TEXT

Engineers in air conditioning will find the "Air Conditioning for Comfort" invaluable as a reference book, while salesmen, students, and others may rely on it to give them a clear knowledge of fundamentals, and of air conditioning methods and equipment.

Send for a copy today. We know you will consider this volume one of the most readable and complete books on the air conditioning science you have yet seen. You will risk nothing in ordering a copy, for you will be privileged to return it for a refund if for any reason it should prove unsatisfactory. Use the coupon at the right to order your copy now.

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CHAP. 5—The Psychrometric Table and Chart
CHAP. 6—Humidity Controllers and Control
CHAP. 7—Heat Transmission Through Barriers
CHAP. 8—Ventilation, Solar and Appliance Heat
CHAP. 9—Heating Systems
CHAP. 10—Air Conditioning Systems
CHAP. 11—Air Conditioning Apparatus
CHAP. 12—Refrigeration and Refrigerants
CHAP. 13—Refrigeration Compressors and Condensers
CHAP. 14—Refrigeration Evaporators and Auxiliaries
CHAP. 15—Record Forms for Heating and Cooling
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10" x 16" Psychrometric Chart..... Inside Back Cover


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Enclosed is $2.00 for a copy of AIR-CONDITIONING FOR COMFORT. If this book should prove unsatisfactory, I will return it within 15 days for a refund.

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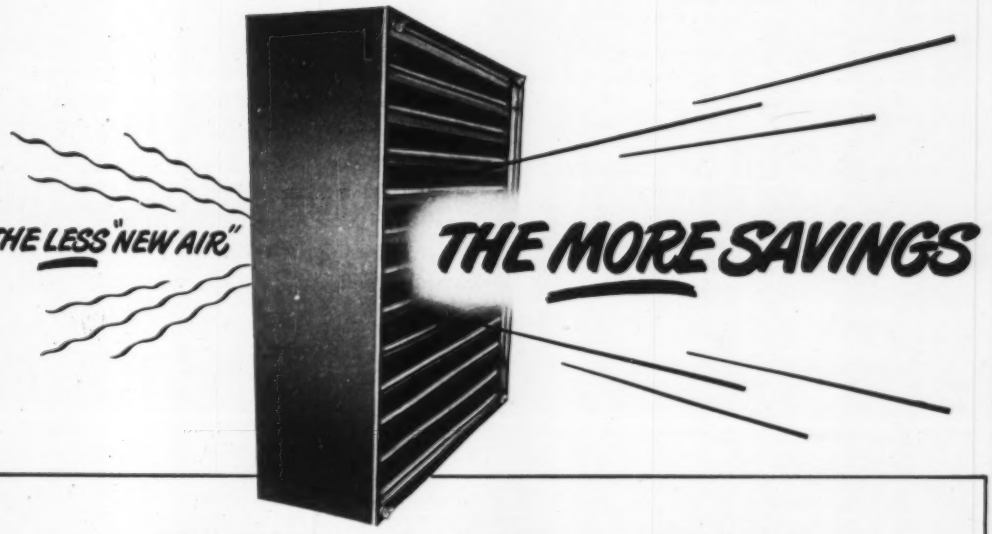


# OVER 6,000 USERS

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# DOREX AIR RECOVERY

With Dorex C Cells in an air conditioning system, the volume of new outside air that must be taken in can be reduced by as much as two-thirds. Thus, cost of original equipment and operating costs are both materially lower.

These facts are of great importance to economy-minded industry today.

It costs over $200 a year to condition every thousand cubic feet of new air circulated per minute. But Dorex Air Recovery "manufactures" fresh air for less than half this cost. Dorex Air Recovery is backed by more than 20 years of experience . . . the biggest names in American business are Dorex users. With Dorex Air Recovery you have more to offer your clients.

Get the complete story of Dorex Air Recovery—technical details, actual savings made, list of users. Write today for Bulletin 117-C.

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*Air Diffusion • Air Purification • Air Recovery*
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**Dept. A-50, 114 East 32nd Street, New York 16, N. Y.**

Please send me, without obligation, full information on Dorex Air Recovery.

**Name**.....
**Position**.....
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**Street**.....
**City**..... **Zone**..... **State**.....

# CHASE COPPER TUBE RADIANT HEATING goes into still another group of homes!

Coils of 60 and 100 foot lengths that eliminate extra connections—flexible, small-diameter tube that bends easily without special tools—solder-joint fittings that make tight joints... these are just a few of the reasons why builders all over the country are turning to Chase Copper Tube for their radiant heating installations.

WHEN *you* plan radiant heating installations, remember that Chase Copper Tube can be installed easily, economically. Its light weight simplifies the handling of the long coils. Its small diameter adapts it perfectly to ceiling installation in the normal plaster depth. *And*... Chase Copper Tube is available for immediate delivery!

**The installation shown** is in a group of 50 houses in the East. (Name furnished on request.) Chase Copper Tube was supplied by Mayer Malbin Co., Inc., Long Island City, N.Y.



**FREE BOOKLET**
*Mail the coupon for helpful radiant heating information*

**Chase Brass & Copper Co.**
**Dept. HPA 550**
**Waterbury 20, Conn.**

Gentlemen: *Please send your book "Suggestions for Designing Radiant Panel Heating with Copper Tube."*

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Name _____

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*the Nation's Headquarters for*
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THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

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**CLOG-PROOF**

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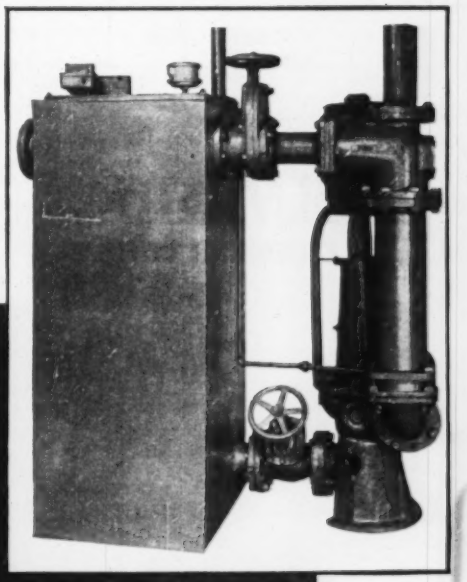
**RELIABLE**



**There's no substitute for The "Chicago"**

# FLUSH-KLEEN

**Sewage Ejector of Proved Performance**

"Flush-Kleens" are positively clog-proof . . . the impellers handle nothing but strained sewage, minimizing wear and maintaining pump balance. Specially designed for plumbing systems in buildings where the maximum inflow is not more than 50 GPM. A second unit can be added any time, to make a duplex installation.

## Look at These Long-established Facts

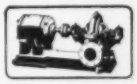
- "Flush-Kleens" are the only absolutely clog-proof sewage pumps; impellers are not required to pass any solids.
- The "Flush-Kleen" will pump anything that will pass through the pipe regardless of type or quantity of material.
- "Flush-Kleen" needs no manual attention other than lubrication and inspection. No labor is needed to dis-assemble and clean.
- "Flush-Kleen" selection is not limited to a narrow pumping range. The impeller maintains dynamic balance over a wide range, preventing strain on shaft and bearing.

*Write for further information and test data on Chicago Pump Company "Flush-Kleen" Sewage Ejectors.*

# CHICAGO PUMP COMPANY

**BUILDING and INDUSTRIAL DIVISION**

**2300 WOLFRAM STREET** — **CHICAGO 18, ILLINOIS**



Condo-Vac, Sure Return, AVC, LVC, Fire, House & Circulating Pumps Pneumatic & Tankless Water Systems

Flush-Kleen Sewage Ejectors Little Giant & Non-Clog Bilge Pumps Pumps for every industrial use.

# SEALMASTER
## BALL BEARING UNITS

## Put Better Bearing Performance In Your 1950 Sales Picture

Make *sure* that the bearings you use are a sales asset to your product . . . and make them a prominent part of your sales story! Many leading manufacturers have improved both their product and its sales effectiveness with SealMaster Ball Bearing Units.

SealMasters offer a combination of advantages found in no other bearing. The complete line includes every type and size to meet any requirement. Call in the SealMaster engineer . . . let him show you how SealMasters can improve your product at no extra cost. There's a catalog available containing complete details . . . write for it today.

**5 Reasons Why SealMasters Improve Your Product**

1. Permanently Sealed
2. Self-Aligning
3. Prelubricated
4. No Housing Wear
5. Floating Retainer

Bearing Division
STEPHEN S-A ADAMSON MFG. CO.

47 Ridgeway Avenue, Aurora, Illinois • Los Angeles, Calif. • Belleville, Ont.

FACTORY REPRESENTATIVES AND DEALERS IN PRINCIPAL CITIES

# It's EASY to install "Payroll Savings"

If you've put off installing the Payroll Savings Plan in your company because you feel it would be "a lot of work," then this advertisement is certainly for you! Because it's really very *simple* to give your employees the advantages of investing in U. S. Savings Bonds the easy, automatic "Payroll" way.

## . . . and 20,000 companies' experience proves it pays!

## HERE'S ALL YOU NEED TO DO

***Appoint one of your top executives as Savings Bond Officer. Tell him to get in touch with your State Director, Savings Bonds Division, U. S. Treasury Department. Here's what happens . . .***

The State Director will provide application cards for your employees to sign—plus as much promotional material and personal help as necessary to get the Plan rolling in your company.

Those employees who want Savings Bonds indicate on the applications: how much to save from their pay; what denomination of Bonds they want; and the inscription information to appear on the Bonds.

Your payroll department arranges to withhold the specified amounts, arranges to get the Bonds, and delivers them to the employees with their pay.

The Bonds may be obtained from almost any local bank or from the Federal Reserve Bank or may be issued by the company itself upon proper certification by the Federal Reserve Bank or Branch in the company's District.

## THAT'S ALL THERE IS TO IT!

In case you're skeptical as to how many of your employees would like to have Payroll Savings, canvass your plant—and be prepared for a surprise. (Remember that pay-check withholdings for Bonds are *not* a "deduction"—the employee takes home his Bonds with his pay.) One leading manufacturer, who had professed little faith in the Plan, found his eyes opened when he asked the people in his plant whether they would like to obtain Bonds in this way. Within only six months after he installed the Plan, half his employees signed up. A prominent aircraft manufacturer, whose company had used the Plan for some time, was not aware of its potentialities until his personal sponsorship increased participation by 500% among his company's employees.

### THE BENEFITS ARE BIG—FOR EVERYONE

The individual employees gain security—they know that the Bonds they hold will return $4 for every $3 at maturity. The company gains from the resultant increased stability and efficiency of its workers. The whole nation gains because Bond sales help stabilize our economy by spreading the national debt and by creating a huge backlog of purchasing power to boost business in the years ahead.

Is it *good policy* to deprive your company of Payroll Savings—even one more pay day? Better at least have a talk with your U. S. Savings Bonds State Director, get the answers to your questions, and *know for sure.*

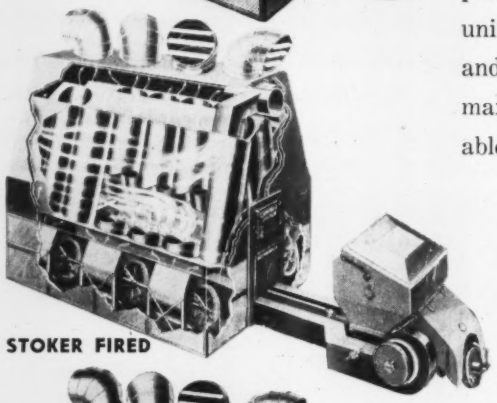
The Treasury Department acknowledges with appreciation the publication of this message by

**Heating Piping & Air Conditioning**

This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and The Advertising Council.

# New Campbell Direct-Fired
# SPACE HEATERS
## for
# BIG JOBS

OIL FIRED



STOKER FIRED

GAS FIRED

Here's the answer to your demand for a large capacity, direct-fired space heater. These new Campbell units are available for all fuels in capacities from 725,000 to 2,160,000 B.T.U.'s. They are extremely compact, with the blowers under the heating unit. The extremely large heating surface and extra heavy welded steel heater assure maximum fuel economy and long, dependable service.

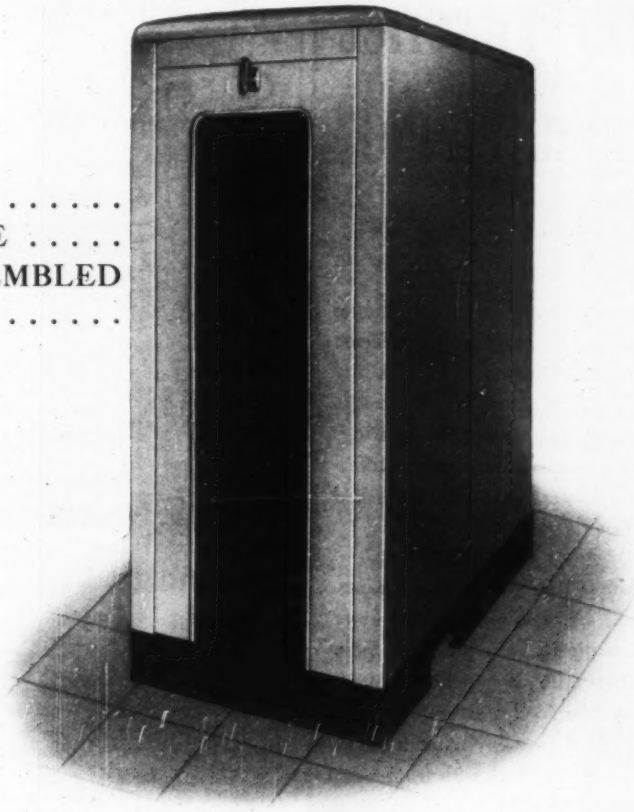
**WRITE:**
Our engineering department will be glad to provide layouts, sketches or suggestions for any large warm air heating installation.

**Campbell**
**HEATING COMPANY**
**3140 Dean Avenue, Des Moines 17, Iowa**

*Every Campbell Heater Backed by 65 Years Heating Experience*

# Designed by Atlas...

STURDY . . . . . .
WELL MADE . . . . .
EASILY ASSEMBLED
BEAUTIFUL . . . . . .



## *Enhance your boiler · · · Enlarge your market with a boiler jacket by Atlas*

These days a builder jacket is more than just a necessary protective covering for your product. Properly designed, it is a means of attracting more prospects, creating more sales, and making both the sale and the installation easier and less costly than ever before.

Beautiful Atlas boiler jackets are designed exclusively for you—tailor-made to fit your market—built to your own boiler specifications. Remember—the average buyer takes performance for granted . . . bases his final choice on appearance.

**Send your boiler specifications to us for cost estimates.**

*Also Manufacturers of Furnace Casings and Blower Housings*

**Atlas MANUFACTURING CO.**

**EUSTIS AT ROBBINS STREET • SAINT PAUL 4, MINNESOTA**

*Send for This Useful Reprint Volume*

# "CORRECT PRACTICE *in* INDUSTRIAL PIPING"

**197 Pages — 8½" x 11" — $1.50**

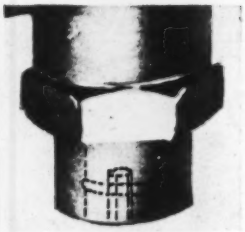
This practical book is made up of outstanding papers and data on industrial piping selected from past issues of "Heating, Piping & Air Conditioning." It is a most comprehensive collection of case studies, showing how various difficult piping problems encountered in different industrial plants were successfully worked out by piping experts.

Design, installation, operation, and maintenance . . . steam, air, gas, oil, process, water and refrigeration piping . . . piping in pulp and paper and steel mills, in automobile plants and breweries, in the food and chemical and textile industries, and in many other types of manufacturing plants are dealt with from many different angles.

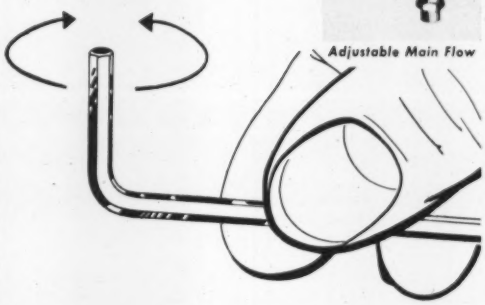
**Send $1.50 today for this book to the address below.**

**KEENEY**
**PUBLISHING COMPANY**
**6 North Michigan Ave. Chicago 2, Illinois**





Adjustable Main Flow



# Adjustable Oil Burner Automatic Valves

Adjustable By-Pass

The Main Flow adjustment in Bulletin 8281 Valve permits the operator to regulate the flow of oil through the valve when it is open. It's a "regulating" as well as a "Shut-Off" Valve. When de-energized, it closes fully, shutting off the flow completely. It is Factory Mutual's Approved.

The By-Pass adjustment in Bulletin 8291 Valve permits a "high or low" flame operation. In other words, the amount of flow can be controlled for full flow or by-pass flow automatically by instrument. It is not a Shut-Off Valve, however, since it does not close completely.

These two ASCO Control Valves are for special cases. Both come in ⅜ and ½ inch pipe size. Both are suitable for gas, light oil, heavy oil (No. 4, 5, 6 and Bunker C) air, water and other non-corrosive fluids at temperatures up to 212° F.

We have other types of Automatic Solenoid Valves for Shut-Off and other purposes not only in the restricted flow types, as these two valves, but in the full flow class. If you will tell us about your automatic control problems, we shall be glad to recommend the proper type.

ASCO Solenoid VALVES

When in need of Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, and Specialized Electromagnetic Controls, come to us.

**Automatic Switch Co.**
**389 LAKESIDE AVENUE · ORANGE, NEW JERSEY**

# Whose job is it to keep them smiling?

Your path and that of the Smiths never may cross. They don't buy your services. Yet, you *can* help make them better customers of your clients!

When you put dependable Bryant gas heating into industrial plants, you help increase production, lower selling prices. When you install Bryant equipment in retail stores, shoppers stay longer, buy more. Thus, you actually influence spending of the Smith budget.

Then, too, the Smiths become happy tenants of the apartment-owning client to whom you sold Bryant individual suite heating. They are willing to pay higher rentals, less inclined to move when they have that reliable Bryant heating.

True, it's not *your* job to keep the Smiths smiling. But, whenever you install Bryant equipment, you help make more loyal customers for *your* customers!

Let the pup be furnace man ... and water boy, too!

**bryant**

**AUTOMATIC HEATING**

The most complete line of gas heating equipment in the nation

Bryant Heater, Dept. 153,
17825 St. Clair, Cleveland, Ohio

( ) Send me the new booklet that tells the Bryant story. ( ) Have your distributor call on me.

Name_____

Company_____

Address_____

City_____ State_____

# A CURTIS Franchise is MONEY IN THE BANK

BECAUSE CURTIS EQUIPMENT

**SELLS and STAYS SOLD**

AND YOU CAN HANDLE ANY...

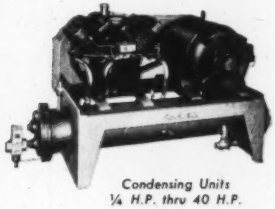
**AIR CONDITIONING • REFRIGERATION • or AIR MOVING JOB**

**WITH THE COMPLETE CURTIS LINE**

With the addition of new 2, 3 and 8-ton package type and 30 and 40-ton remote type air conditioners to the comprehensive Curtis line, the Curtis dealer is in his best position in history. Long known for their performance record, Curtis Packaged Air Conditioners are built to operate efficiently with minimum installation and maintenance costs.

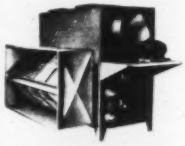
Supported with big, colorful full page advertisements in the Saturday Evening Post, Time, Newsweek and many other consumer magazines, plus an assortment of powerful sales promotion helps, the Curtis dealer will find Curtis equipment is recognized and wanted by consumers everywhere.

*Packaged Type 2½ to 8 tons*



*Condensing Units ¼ H.P. thru 40 H.P.*

*Central Type 10 and 15 tons*



*Ceiling and Floor Type Air Handling Units*

*Evaporative Condensers, and Cooling Towers to Match*

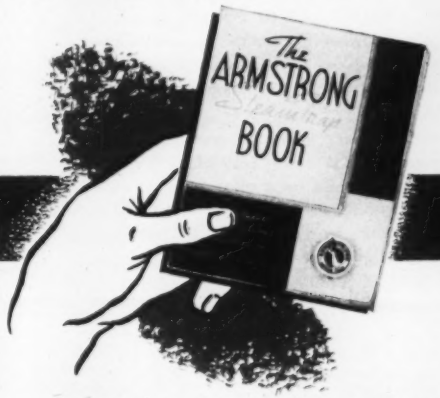
**CURTIS Refrigerating Machine Division**
*of Curtis Manufacturing Company*
**1950 Kienlen Avenue, St. Louis 20, Mo.**

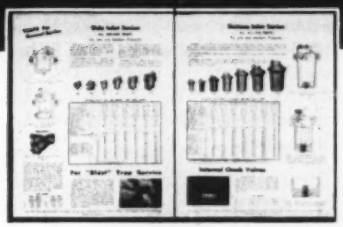
96 YEARS of SUCCESSFUL MANUFACTURING

R50-2

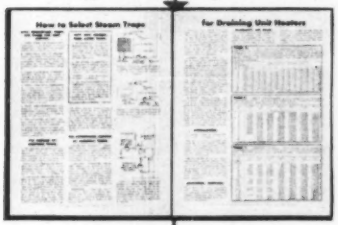
# "You can engineer any trapping job with this book"

**YOU CAN'T GO WRONG**

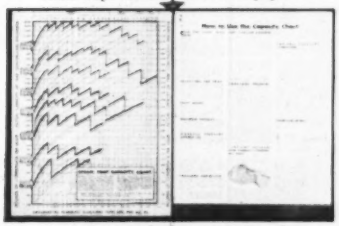


Physical data and prices on all sizes and types of Armstrong steam traps.



How to calculate condensate loads and select traps for all classes of equipment.



Actual hot condensate capacity chart for every Armstrong trap, recommended safety factors and specific recommendations for many types of equipment.

THERE is no guess work about steam traps or steam trap selection when you have the 36-page Armstrong Steam Trap Book to work with. You don't waste money on traps that are too big for the job. You don't get inefficient drainage with traps that are too small.

This book explains the design, operation and advantages of Armstrong steam traps, specifies materials used, gives complete dimensional data, includes list prices, actual capacities under working conditions. There are 10 pages of tabular and technical data explaining how to calculate condensate loads and select the correct trap for the job, complete instructions on installation and maintenance. The Steam Trap Book also describes Armstrong traps for draining moisture from compressed air systems, Armstrong steam humidifiers for adding moisture to dry air and Armstrong non-condensable gas purgers for removing air from refrigeration systems.

Anyone is welcome to a copy of this useful guide to good trapping practice. Send for yours today.

**ARMSTRONG MACHINE WORKS**
**874 Maple St., Three Rivers, Mich.**

# ARMSTRONG STEAM TRAPS

# Get these 5 important advantages with the C-E Premier Boiler

**1. Simplicity** – The C-E Premier Boiler is a simple, down to earth unit... simple to operate, simple to maintain. A minimum of controls – no complicated gadgets. You can depend on the C-E Premier for reliable day in and day out performance with minimum attention.

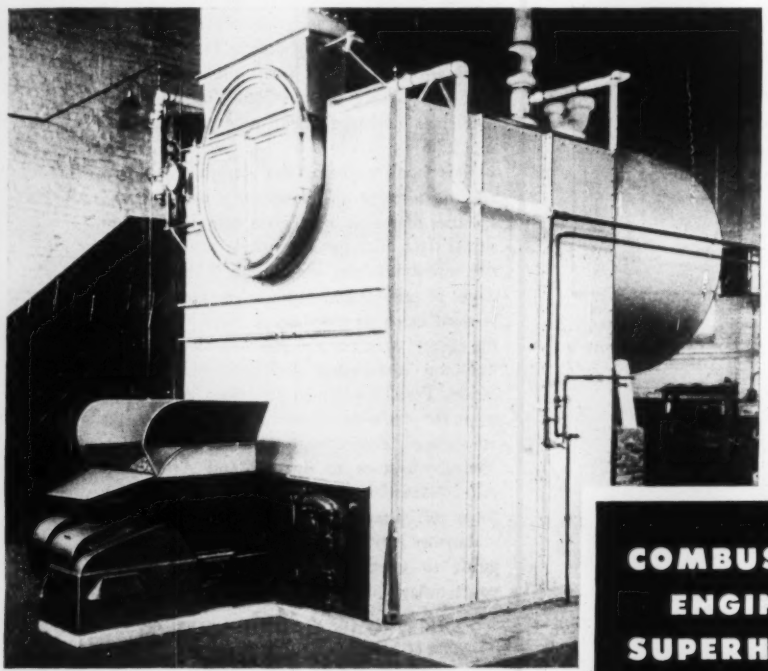
**2. Fuel Versatility** – You'll want the one best method of firing for your particular fuel conditions. The C-E Premier Boiler is designed for stoker firing of either anthracite or bituminous coal or for oil or gas. Moreover, should a change in your local fuel conditions occur, the Premier can be readily converted from one type of firing to another.

**3. Low Maintenance** – The C-E Premier Boiler is a sturdily built, compact unit with all seams fusion welded. No cross braces inside the vessel to get out of repair. All parts of the boiler are readily accessible for cleaning and maintenance. Tubes are accessible at both ends through large flue doors in the rear combustion chamber and in the smokebox.

**4. Low First Cost** – The C-E Premier Boiler is a completely standardized unit designed for stock production. The savings in engineering and erection incident to standardization are passed along to you in the form of lower first cost.

**5. Background** – Combustion Engineering-Superheater has had over sixty years' experience in building boilers of all types, including some of the largest central station installations in this country. This wide experience is reflected in the design and workmanship of every Combustion boiler. It will pay you to investigate C-E before you buy.

B-401



The Premier Boiler is available in seven sizes ranging from 75 to 375 rated horsepower. The unit shown, installed in the plant of a machinery manufacturer, is rated at 120 hp. It is fired by a C-E Skelly Stoker.

**COMBUSTION ENGINEERING–SUPERHEATER, INC.**

200 Madison Avenue · New York 16, N.Y.

ALL TYPES OF STEAM GENERATING FUEL BURNING AND RELATED EQUIPMENT

# YOU DON'T HAVE TO PAMPER

## THE "King-clip" VALVE!

**Fig. 1640**
Iron Body Bronze Mounted "KING-CLIP" Gate Valve 150 lb. S.P.—200 lb. W.O.G. For steam, water, gas, air, oil and gasoline service.

**THIS STURDY IRON BODY GATE VALVE** is built to stand the gaff of hard usage. It is a composite of the strong construction of the original "Clip" valve pioneered by Lunkenheimer many years ago and improved design features to meet modern-day conditions. It provides maximum resistance to distortion, piping stresses and wrenching strains.

Aside from its basic rugged proportions, the "KING-CLIP" embodies these distinctive features: • non-corrosive stem-thread bearing cast in bonnet • large drain channels that really drain the bonnet • sharply tapered bronze disc that seats tight • bronze rolled-in seat rings • coarse stuffing box threads that resist corrosion and stripping • hexagon head gland • Lunkenheimer-developed stem material that eliminates stem-thread failure due to wear • easy disassembly for servicing.

Ask for Circular No. 561 which illustrates the numerous patterns in which the "KING-CLIP" is available—iron body trim with bronze and various alloys, and all-iron . . . for a wide variety of services. You'll find one or more types which you can use to profitable advantage.

**LUNKENHEIMER DISTRIBUTORS**
***save you money . . . and "headaches"!***

Distributors' stocks and service are a money-saving and time-conserving convenience. The more you use these handy facilities, the less you need spend for stock-room inventory and "sleuthing" for sources of supply. Call your Lunkenheimer distributor and profit from his unfailing service—not only on valves, but on the numerous other commodities necessary to keep industry in pace with the needs of these fast-moving times.

ESTABLISHED 1862
**THE LUNKENHEIMER CO.**
—"QUALITY"—
**CINCINNATI 14, OHIO, U.S.A.**
NEW YORK 13 • CHICAGO 6 • BOSTON 10 • PHILADELPHIA 34
EXPORT DEPT., CINCINNATI 14, OHIO, U.S.A.

*The "King-clip" is king of all clip type valves!*

KAHN & JACOBS
Architects

GEORGE A. FULLER CO.
General Contractor

JAROS, BAUM & BOLLES
Mechanical Engineers

KERBY SAUNDERS, INC.
Heating, Ventilating and Air Conditioning Contractors

JARCHO BROS.
Plumbing Contractor

# JENKINS VALVES

LOOK FOR THE DIAMOND MARK

SINCE 1864 TRADE JENKINS MARK

Jenkins Bros.

4715 JENKINS VALVES! At 100 Park Avenue, as in all large buildings and plants, the many valves required represent a major investment. Obviously, maintenance costs would become excessive if valves proved inferior. That is why, today, when low-cost operation is a controlling factor in construction and modernization plans, so many builders take the long view of valve economy. They choose Jenkins Valves, for proved endurance. Despite their extra value, you pay no more for Jenkins Valves. *Sold through leading Industrial Distributors everywhere.* Jenkins Bros., 80 White Street, New York 16; Jenkins Bros., Ltd., Montreal.

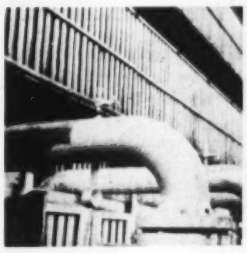
# EQUIPMENT DEVELOPMENTS...

*For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1950 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk, equipment and manufacturer not listed.*

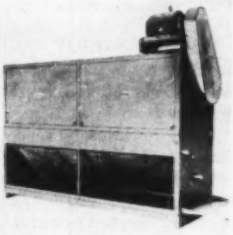
**HPAC 4345—CORROSION RESISTANT TAPES**—"Polyken" No. 882 and No. 888 are two new industrial tapes developed by Polyken Industrial Tape Dept. of Bauer & Black, Div. of Kendall Co., 222 W. Adams St., Chicago 6. Both are resistant to corrosion, the former being black in color and the latter aluminum in color.

These tapes consist of an oriented polyethylene film with a synthetic adhesive applied to one side. The material is said to be readily applied to clean surfaces by hand. According to the manufacturer, its elasticity provides permanent pressure when wrapped around a pipe and this pressure prevents moisture from seeping under the tape edges.

The tapes are recommended for weatherproofing insulating materials and for protecting buried pipe against corrosion. They are available in various widths, in cores of 1½ and 3 in. inside diameter, and are packed in 100 ft rolls. The illustration shows the No. 888 tape applied to a discharge line on a gas cooling tower.



Industrial Tape



Air Conditioner

**HPAC 4346—CENTRAL SYSTEM CONDITIONER**—A completely new line of central system "Weathermakers" is now available from Carrier Corp., Syracuse, N. Y.

Said to be light in weight, powerful in performance, and quiet in operation, the new air conditioning units (models 39S and 39T) are available in sizes to cover a range of from 5 to 75 tons of refrigeration capacity.

Some of the features stressed by the manufacturer are: 1) complete sectionalization to provide ready assembly on the job, 2) easy access to all sections of the unit after it is assembled, 3) quiet operation through minimizing air noise by the use of a new type of fan assembly—a spokeless, forward curve blade wheel mounted on a large diameter, hollow shaft, with self-aligning rubber mounted bearings and adjustable cutoffs, 4) the use of unusually heavy and nonhygroscopic insulation in the fan section, and 5) the arrangement of the cooling coil section at a 45 deg angle to provide a large cooling surface and a high airway velocity.

Heating coil and bypass sections are separate, and all coils are available in aluminum or copper fins on copper tube. All metal parts are coated with chlorinated rubber to prevent corrosion.

**HPAC 4347*—GAS FIRED UNIT HEATER**—A new line of self contained, gas fired unit heaters has been developed by American Blower Corp., Detroit 32, Mich. The new units are available from stock in seven sizes with capacities ranging from 70,000 to 230,000 Btu per hr input.

Construction features include an aluminized steel combustion chamber and heat exchanger (for corrosion resistance) which are welded together into a single assembly. All models are finished in a baked enamel steel casing that is protected against rust and corrosion through a bonderizing process. Burners are of cast iron, are accessible, and are adaptable for use with manufactured, mixed, natural or liquefied petroleum gases. All units have been approved by the American Gas Association.

**HPAC 4348—RECORDS DISTANT PRESSURES**—A system for electronically recording pressures up to 30 miles from the point of measurement has been developed jointly by Manning, Maxwell & Moore, Inc., and the Brown Industrial Division of Minneapolis-Honeywell Regulator Co., 4534 Wayne Ave., Philadelphia 44.

**FOR YOUR CONVENIENCE** [5-50]

**Heating, Piping & Air Conditioning**
**6 N. Michigan Ave., Chicago 2, Ill.**

**Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature**

***(Circle each HPAC number in which you are interested)***

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 4345 | 4346 | 4347 | 4348 | 4349 | 4350 | 4351 | 4352 | 4353 | 4354 |
| 4355 | 4356 | 4357 | 4358 | 4359 | 4360 | 4361 | 4362 | 4363 | 4364 |
| 4365 | 4366 | 4367 | 4368 | 4369 | 4370 | 4371 | 4372 | 4373 | 4374 |
| 7634 | 7635 | 7636 | 7637 | 7638 | 7639 | 7640 | | 7642 | 7643 |
| 7644 | | 7646 | 7647 | 7648 | 7649 | 7650 | 7651 | 7652 | 7653 |
| 7654 | 7655 | 7656 | 7657 | 7658 | 7659 | 7660 | 7661 | 7662 | 7663 |
| 7664 | 7665 | 7666 | 7667 | 7668 | 7669 | | | | |

Name ..... Title.....

Company .....

Address .....

City..... Zone..... State.....

A typical application for such a system is said to be the determination of levels of distant reservoirs.

The system, designed to permit transmission of pressure up to 50,000 psi, consists of the "Microsen" transmitter, which senses pressure change and converts the change into electrical energy, and a remotely located "Electronik" indicating or recording instrument to which the energy is transmitted. Multi-point recorders can be used to log a number of pressure records on one chart.

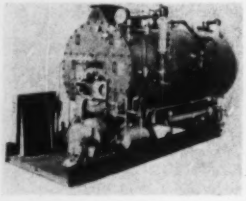
**HPAC 4349—HEAT EXCHANGER**—A new line of standardized exchangers, featuring all-cuprous, removable tube bundle construction, is now in quantity production by Ross Heater & Mfg. Co., Inc., 1407 West Ave., Buffalo 13, N. Y.

Designated type BCP, the line is available in a broad range of sizes. Originally designed for service on Navy combat vessels, it has been extensively redesigned. Not only has it been adapted to low-cost, quantity production, but it now embodies larger transfer surface.

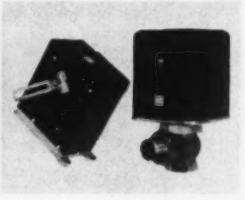
**HPAC 4350—PACKAGED BOILER**—An addition to its line of self contained 15 to 500 hp boilers has been made by Cleaver-Brooks Co., 326 E. Keefe Ave., Milwaukee.

The new unit, called the model LR, features an automatic rotary burner designed to provide unusual flexibility in burning heavy oils or industrial gases. A single, low-speed blower furnishes air for combustion. A totally enclosed, drip and dustproof panel is used to protect all major electrical controls. Electronic combustion safety devices and dual low-water cutoffs are standard equipment. According to the company, the simplified design of a combination gas-oil burner permits rapid changeover from oil to gas or the reverse in less than a minute.

The new model is of all-welded construction and is built in accordance with the ASME boiler code.



Packaged Boiler



Ventilator Controls

**HPAC 4351—UNIT VENTILATOR CONTROLS**—Used in schoolrooms, auditoriums, and gymnasiums, unit ventilator control systems of Barber-Colman Co., Rockford, Ill., have been redesigned for improved performance and dependability.

Cam-operated limit and auxiliary switches are used for all interlocking cycles. Operators are powered by electric motors equipped with hardened machine cut gears and are said to be noiseless and trouble-free.

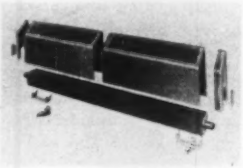
Controls are supplied with mounting brackets and adjustable linkages for easy installation in any unit ventilator. For minimum servicing of units in inaccessible locations, oil immersed operators can be supplied.

**HPAC 4352—FINNED WALL RADIATION**—A new, low cost system of wall-fin type radiation for a variety of commercial and industrial applications has been developed by The Trane Co., La Crosse, Wis.

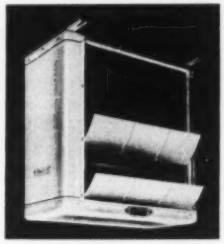
Important design advances are said to include easily installed cabinets in standard unit lengths that lock together with push-in rivets, and a new hanger that rides with expansion and contraction of the heating element. This feature is designed to prevent damage from buckling, loosened supports and other stresses.

Included in the line are both steel pipe and nonferrous heating elements in standard lengths from 2 to 12 ft in 6 in. increments. A variety of cabinets run from 2 to 6 ft in 6 in. increments, grilles from 2 to 10 ft in 6 in. increments.

This radiation is recommended for "high spot" heating around skylights, exterior walls, windows and other points of high heat loss in industrial applications. In schools and commercial installations elements are said to create a "blanket of heat" of any desired length along strip, show and picture windows.



*Above:* Wall Radiation



*Right:* Unit Cooler

**HPAC 4353—UNIT COOLERS**—Kramer Trenton Co., Trenton, N. J., has announced a new line of "Kay-Tee" unit coolers offered in seven sizes for use with compressors from ¼ to 2 hp.

Tubes are closely spaced with a small fin overhang. This is said to result in a low fin to tube ratio and a high heat transfer factor. The tubing in each row is made of one continuous length. To accomplish this, the tubing is bent and inserted into the fins through a slot. The return bends of one end are flattened to facilitate this operation and the tubing is then expanded under 3000 psi pressure to effect a bond between the tubing and fins and also to re-expand the flattened return bends to normal size.

Since coils are designed for normal pressure drop, standard expansion valves can be used and the company does not recommend the use of external equalizers.

**HPAC 4354—WATER COOLING TOWERS**—Marley Co., Inc., Kansas City 15, Kan., has added a 20 ton "Aquatower" to its line of water cooling towers and has incorporated a number of improvements on all models.

Interiors of all towers are now lined with a rubber coating for corrosion resistance. A new and quieter, deep pitch fan used. It is said to operate at one half the usual speed. According to the company, this plus the rubber lining provide unusually quiet operation.

Available in sizes from 3 to 50 tons, the towers are packed and completely assembled. Features include open distribution basins, redwood filling from top to bottom, and totally enclosed motors.

[*Continued on page 202*]

"The Air Force crash entry suit consists of multiple layers of metallic foils and high-temperature-resisting conductive insulation, and is designed to provide adequate protection up to an exterior temperature of 2000°F."

*From a letter by*
COL. E. J. KENDRICKS, Medical Corps (USAF),
Chief, Aero-Medical Laboratory, Engineering Division.

**U. S. AIR FORCE CRASH FIRE FIGHTERS DEMONSTRATE:**

## *Radiation dominates heat flow in air spaces (in buildings)*

## *Conduction and Convection are minor*

## *Multiple layers of low-emissive aluminum do not absorb nor emit appreciable heat*

Infra-red heat rays travel through space, including icy-cold air, in every direction, up, down, sideways, from warm to cold. They engender no temperature until absorbed by a surface.

A news release from Wright Patterson Air Force base says of the accompanying photograph: *"In the center the 'bunkin' suit, now in use by airplane crash fire-fighters, has become too hot for its wearer and is being wet down. The aluminum foil laminate suit at the left, developed by AMC's Aero-Medical Laboratory, was found to give its wearer the greatest comfort and protection and suffered least damage during the test. The foil reflects the extreme heat and helps the wearer retain a relatively low body temperature while fighting airplane crash fires."*

Multiple layers of accordion aluminum permanently compartmented with cellular reflective spaces, reject 97% heat rays and emit only 3% on opposite side. This structure, available commercially, is technically called Infra Accordion Aluminum Insulation. Installed between wood joists in new construction, material and labor, Type 4 Infra costs less than 7½¢, Type 6 less than 9¢ sq. ft.

**Details of how multiple accordion aluminum with reflective air cells stops waste of heat or its unwanted intrusion, including heat by convection and conduction, in residential, commercial, and industrial buildings; and prevents vapor flow and condensation, sent on request.**

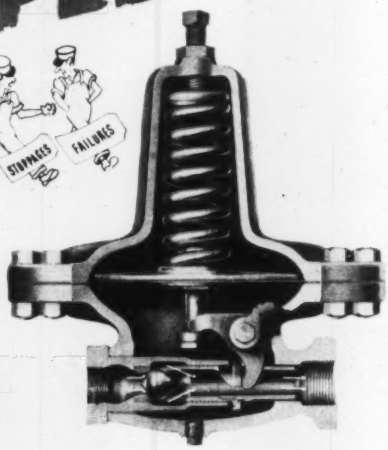
***Get Valuable Free Copy*** **of new, revised "Simplified Physics of Thermal Insulation," authoritative, simply-written, 44-page manual on heat and vapor flow, condensation, radiant heating, etc. Tells about Radiation, Convection and Conduction. Just off the press. Master Chart gives *k*, C, R, and U factors of all insulations, of all thicknesses, weights, densities.**

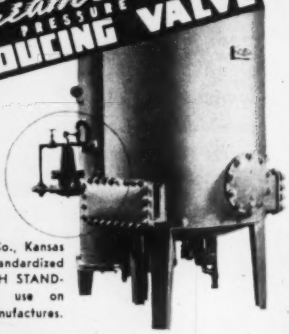
**THERMAL FACTORS, TYPE 6 INFRA**
**Down-Heat C.044, R22.72 equals 7½" DRY Rockwool**
**Up-Heat C.080, R12.50 equals 4" DRY Rockwool**
**Wall-Heat C.073, R13.69 equals 4½" DRY Rockwool**
**VAPOR PERMEABILITY equals ZERO**

**INFRA INSULATION, INC.**
**10 Murray Street New York, N. Y.**
**Telephone: COrtlandt 7-3833**

INFRA INSULATION, INC.
10 Murray Street, New York, N.Y. Dept. H-5
Please send "Simplified Physics of Thermal Insulation."
Name_____
Firm_____
Address_____
☐ Send Prices of Infra Insulations ☐ Send Sample

# THESE TROUBLEMAKERS STOPPED IN THEIR TRACKS BY THE CASH STANDARD Streamlined TYPE 1000 PRESSURE REDUCING VALVE





The Butler Mfg. Co., Kansas City, Mo. has standardized for years on CASH STANDARD valves for use on vacuum stills it manufactures.

THE USERS TELL WHY IN STATEMENTS BELOW . . .

Check what they say against the 10 points we list . . . . .

**An Ice Machine Co. says—**

"The streamlined '1000' pressure reducing valves that we have installed on ammonia liquid lines to INSURE UNIFORM PRESSURE at the expansion valves have proven very satisfactory."

**A Manufacturing Corp. says—**

"We have not had an opportunity to check capacity or cost savings but are pleased with the SMOOTH OPERATION in reducing from 140 psi to 4 or 5 psi."

**A Products Co. says—**

"Our '1000' unit has been in use about 20 hours daily for about 2 years. In this time there has been NO FAILURES—NO INTERRUPTIONS and NO MAINTENANCE. We reduce from 100# to 20# and have practically forgotten we had the valve."

**A Metallizing Co. says—**

"ACCURATE PRESSURE CONTROL is vital to our operations. Your '1000' valve has given us very good service."

**A Corn and Soybean Products Mfg. Co. says—**

"From our experience the type '1000' reducing valve is an excellent direct operated type valve. GOOD PRESSURE CONTROL, TIGHT CLOSURE, and LOW MAINTENANCE COSTS are all factors which influenced us to use a good many of these valves in our plant."

1. Maximum capacity when needed most.
2. Accurate pressure control under toughest working conditions.
3. Trouble-free service.
4. Smooth operation.
5. Tight closure.
6. Speedier production results.
7. Elimination of failures.
8. Cost-saving operation.
9. No spoilage.
10. Practically zero in maintenance.

• WRITE FOR BULLETIN 962

CASH STANDARD CONTROLS.. VALVES

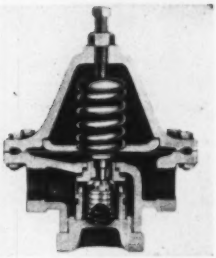
**A. W. CASH COMPANY**
DECATUR, ILLINOIS

•

**BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES**

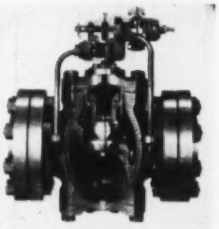
*Send for them*

•



Bulletin 950—features the CASH STANDARD Type D Single Seat Pressure Reducing and Regulating Valves for use with most fluids. Shows simple inner working parts that save in maintenance. Diagram explains how valve works. Blueprint shows simplicity of installation.

Bulletin 956—features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.



Bulletin 966—features the CASH STANDARD Self-Contained, Pilot Operated Type 10 Pressure Reducing and Regulating Valve for use with water or air; with any gas or oil that is non-corrosive; and with refrigerating fluids such as Ammonia and Freon. Many interesting particulars explained such as: how valve works, tight seating, large capacity, no waste, no water hammer or chatter.

## ARCHITECTS

The "flexibility" of Vulcan continuous line radiation makes the architect's job easier because Vulcan can be so easily figured into the design of any architectural unit with uniformly satisfactory results.

## HEATING CONTRACTORS AND ENGINEERS

Heating contractors and engineers are enthusiastic about Vulcan because it is so easy to install . . . comes cut to length, requires few fittings and supports, can be used with either steam or forced hot water systems.

**They all say . . .**

# *"Vulcan has no Equal"*

## MAINTENANCE ENGINEERS

Once Vulcan is installed, maintenance engineers (and home owners too) can forget it because it requires no upkeep. All units made from seamless steel pressure tube, or copper water tube. Fins *imbedded* by special Vulcan process and *offset* for complete rigidity *guaranteed* to remain tight under conventional operating conditions.

## THOSE WHO KNOW . . .

All who have specified and or installed Vulcan in public buildings, schools, hospitals, trains, ships *and homes* . . . say Vulcan has no equal for *Quality, Comfort* and *Economy.*

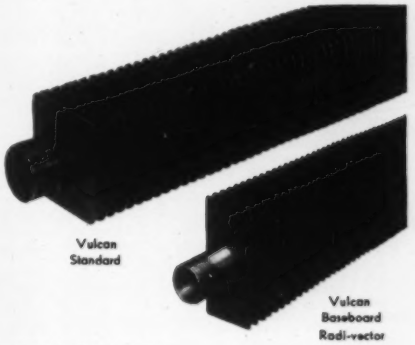
***Representatives in Principal Cities.***

**Made in Canada, under trade name of Heal Radiation, by the Vapor Car Heating Co. of Montreal.**

*Illustrated Bulletins on Vulcan Standard (Commercial) — Vulcan Baseboard Radi-vector (Residential).*

**THE VULCAN RADIATOR COMPANY**

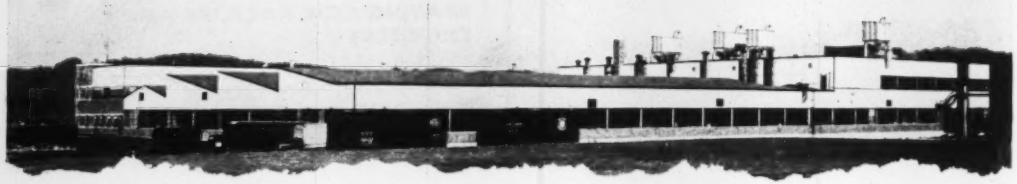
**26 FRANCIS AVE. HARTFORD 6, CONN.**




## THIS IS IT . . .

Vulcan Standard available in 2 sizes in steel or copper for commercial, industrial and public buildings: attractive grille or covers for 1, 2 or 3-high installations. *Also Vulcan Baseboard "Radi-vector" in 2 sizes, steel or copper. Attractive covers for the best design in home heating.*

# Again it's the LIGHT METAL selected as the RIGHT METAL

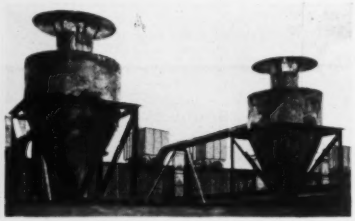


## for this important construction at a B. F. Goodrich plant

The Huffman-Wolfe Co. of Columbus, Ohio, contractors for this interesting installation at the Plastic Products plant of B. F. Goodrich Company in Marietta, had definite reasons for choosing Reynolds Aluminum. This picture story tells why sheet metal men are turning to aluminum as the right metal for more and more jobs.

Reynolds Aluminum is the right metal from a profit standpoint, too. When you add up the advantages of aluminum, the total reads "profit". Three times the working metal per pound—more complete shop fabrication—speed in handling and erecting are exclusive advantages of this lighter, longer-lasting metal.

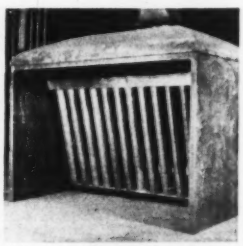
Special benefits are reported with each new use of *Lifetime* Aluminum for sheet metal construction. The picture report here shows how aluminum is the right metal for you when the job has to be RIGHT. Since it costs no more, why not use the best and the easiest metal to work with . . . use Reynolds Aluminum, conveniently stocked by a distributor near you. Just look for Reynolds Aluminum listed in the yellow pages of your telephone directory. For more complete information, write to address below.



*Aluminum dust collectors save plastic trimmings for reprocessing. This metal rules out red-rust, solves the big cost of continued repainting.*

**Send for this helpful, 32 page book, Aluminum in Heating, Ventilating and Air Conditioning. Reynolds Metals Company, Aluminum Division, 2566 South Third Street, Louisville1, Kentucky.**

*Corrosive fumes won't eat into these aluminum exhaust stacks, but they'd murder many another metal. Aluminum is best in industrial atmospheres.*



*This exhaust hood is above a tank for highly explosive solvent. Aluminum's non-sparking quality is a safety factor here.*

REYNOLDS METALS

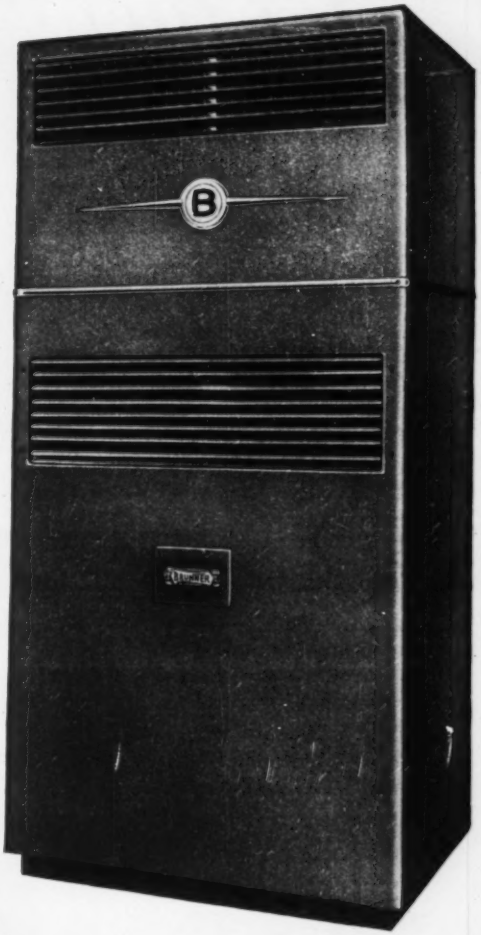
**REYNOLDS *Lifetime* ALUMINUM**

CONSIDER ALUMINUM • CONSULT REYNOLDS • THE COMPLETE ALUMINUM SERVICE

BRUNNER SINCE 1906 AIR CONDITIONING builds business

# WHAT'S KEEPING YOU AWAY

*from Air Conditioner Profits?*



**PRODUCT** Brunner self contained floor type room air conditioners are available in 4 popular sizes—3, 5, 7½ and 10 ton. Completely Brunner built...backed by 44 years of engineering "know how." *By every standard of comparison an outstanding product worthy of your confidence.*

**INVOLVEMENT** Packaged air conditioning is simple to sell, install and service. No involved technical knowledge is required. Recommendations are determined through a few easily figured facts. Packaged air conditioning is a natural part of any refrigeration and appliance business.

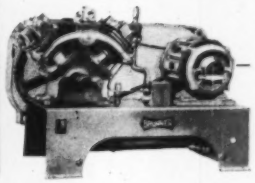
**SALES HELP** Brunner field-sales engineers are so located across the country as to be readily available to help on every occasion when called upon. Brunner advertising to "users" in many fields has paved the way to recognition and acceptance of Brunner as the top value in air conditioning.

**MARKETS** All around you! Practically every business depending upon store traffic, wants and needs air conditioning. The opportunities are legion. The Brunner field man will show you how to contact and close sales.

**PROFIT** Brunner Air Conditioning builds business ...yours and your customer's. Don't let this extra income pass you by. Write or wire for a Brunner representative to spread the facts before you. You can't miss recognizing the superiority of Brunner Air Conditioners as a product and as a *new business* opportunity.

BRUNNER SINCE 1906 **AIR CONDITIONING**

- **Self Contained 3 HP. to 10 HP.**
- **Remote Type 5 HP. to 75 HP.**



**BRUNNER MANUFACTURING CO., Utica 1, New York, U.S.A.**

**REFRIGERATION CONDENSING UNITS by BRUNNER** SINCE 1906

**AIR AND WATER COOLED MODELS**—*a size and type for every purpose...*¼ **HP. TO 75 HP.**

# MONEY IN THE TILL

## *for them . . . for you*

STORES

NIGHT CLUBS

RESTAURANTS

HOTELS

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FACTORIES

UTILITIES

Name a business in your community and we can tell you how others exactly like it have profited by electrostatic air cleaning. Clean air pays in so many ways — in more patronage, better service, less spoilage, fewer losses, lower cleaning and redecorating costs. No wonder it is now so widely recognized as a profitable investment.

*Electrostatic air cleaning can mean more money in your till, too.* There are profit opportunities all around you. Every old customer, every new prospect presents an opportunity to install a Raytheon Precipitator Don't overlook this new and growing source of profitable business. Write for complete information today.

**RAYTHEON MANUFACTURING COMPANY**

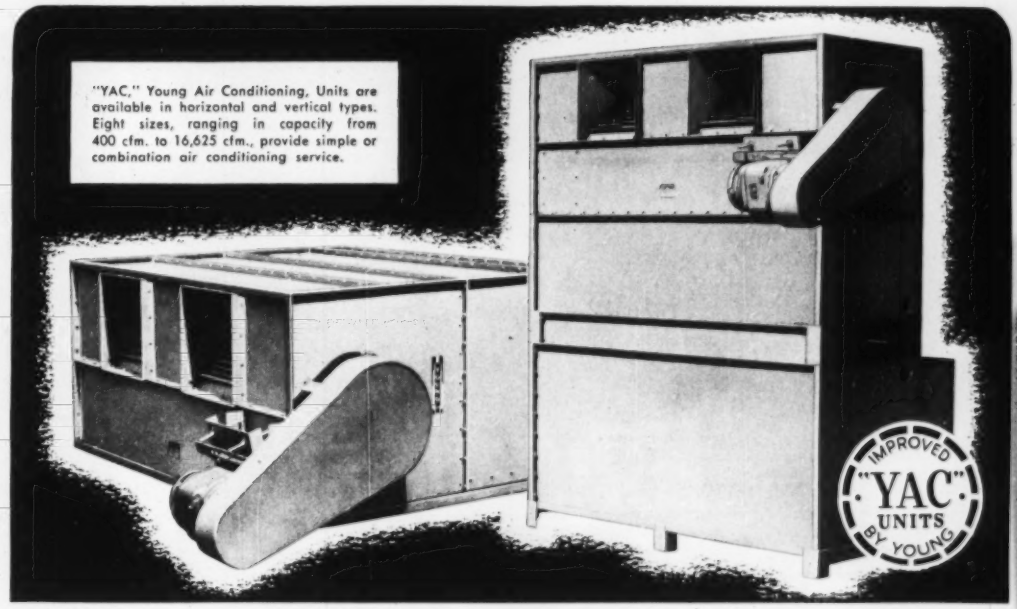
**DEPT. 6460-HP, WALTHAM 54, MASSACHUSETTS**

RAYTHEON

# RAYTHEON PRECIPITATORS

**(ELECTROSTATIC AIR CLEANERS)**

# Get Any Service Combination With YOUNG AIR CONDITIONING UNITS


"YAC," Young Air Conditioning, Units are available in horizontal and vertical types. Eight sizes, ranging in capacity from 400 cfm. to 16,625 cfm., provide simple or combination air conditioning service.
IMPROVED
"YAC"
UNITS
BY YOUNG

Whether your requirements call for year-round or seasonal air conditioning . . . for heating, cooling, humidifying, dehumidifying, filtering, and circulating of air *in any combination* . . . Young Air Conditioning Units can meet them exactly. Young co-ordinated, sectional design makes possible complete versatility, compactness, ease of handling, and low original and maintenance costs. Specify "YAC" Units made only by Young, specialists in the design and manufacture of heat transfer products for more than two decades. Coupon below will bring you further details.

**YOUNG**

Heat Transfer Products for Automotive and Industrial Applications.

Young Quality
T. M. Reg. U. S. Pat. Off.

Heating, Cooling, and Air Conditioning Products for Home and Industry.

**YOUNG RADIATOR COMPANY**
DEPT. 510-E, RACINE, WISCONSIN

Plants at Racine, Wisconsin and Mattoon, Illinois
Sales and Engineering Offices in All Principal Cities

**LEARN HOW "YAC" SECTIONAL DESIGN CUTS HANDLING AND INSTALLATION TIME . . . . .**

**YOUNG RADIATOR COMPANY**
**Dept. 510-E**
**Racine, Wisconsin**

*Please rush me full particulars on:*

- ☐ "YAC" Units
- ☐ Convector-Radiators
- ☐ Unit Heaters
- ☐ Heating and Cooling Coils

Name _____

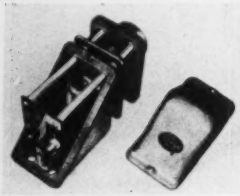
Address _____

City _____ Zone _____ State _____

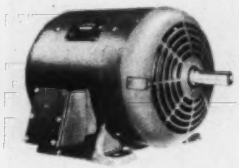
[*Continued from page 194*]

**HPAC 4355—OIL BURNER FLAME FAILURE CONTROL**—"Fireye" system FF-1 is designed to provide flame failure protection for commercial gun type, light-oil burners. The manufacturer, Combustion Control Corp., 77 Broadway, Cambridge 42, Mass., recommends the new system for use with burners having a capacity in excess of 5 gph—such as in schools, churches, apartments, and commercial establishments.

The system consists of photoelectric scanner type 45PH5 and programming control 24PJ8. In the event of light off failure, lockout is said to occur 5 sec after power has been applied to the burner motor and electric ignition. If flame failure occurs during an operating cycle, safety lockout is said to occur within 2 to 4 sec.



Flame Control



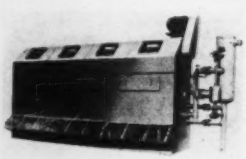
Corrosion Resistant Motor

**HPAC 4356—CHEMICAL MOTORS**—New Type CSP "Life-Line" motors especially designed for applications where corrosive fumes and liquids are encountered, are available from Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30.

Frames, brackets, hoods, and other exposed parts are alkali-cleaned, hot-water rinsed, then rinsed in chromic acid spray. After drying, they are sprayed with phenolic-alkyd-type enamel and baked. Additional protection is provided by a coat of gray enamel and two to four baked dips of thermoset varnish, followed by a final coat of gray lacquer.

These motors use bronze split-hub, clamp-type blowers for corrosion resistance. Rotating neoprene slingers on the shafts between rear brackets and hoods are used to prevent the entrance of dirt or liquids into the bearing housings. Stator windings are double-dipped and baked in thermoset varnish. All hardware is dipped in slushing compound prior to assembly and the gasketed conduit box can be rotated to meet installation requirements. Factory sealed prelubricated bearings are used.

**HPAC 4357—INDUSTRIAL CONDITIONERS**—Six new models of industrial, dry coil conditioners of the vertical type are being produced by York Corp., York, Pa. The six sizes range in capacities up to 25,000 cfm.



Units are said to be ideally suited for refrigerated storages and are recommended for use in dairy, ice cream, meat packing, brewery, and other processing plants, in addition to cold storage warehouses.

The coil and fan sections are shipped separately for easier installation. All seams of the galvanized casing


# design

## MAKES ALL THE DIFFERENCE IN WELDING TEES, TOO

When seamless drawn welding tees were introduced some 17 years ago, they represented a great advance over cut-and-welded intersections. Even so, they still had certain inherent weaknesses. Their design was unstable under high internal pressure and bulging resulted at the flat spots of the side walls. The relatively weak crotch area, carrying an unequal share of the load, usually gave way first in bursting tests. To compensate, tees were made excessively heavy.

Tube Turns research engineers developed a new welding tee design based on the sphere, nature's strongest form for resistance to internal pressure. This shape, with necessary modifications, became the basis for an entirely new welding tee design.

In the Tube-Turn barrel-type tee, the internal pressure load is carried largely in direct tension. And, in bursting tests involving the old and new design, it proved capable of withstanding 22% more pressure before yielding. It is at least 25% stronger than the code (ASA B16.9) requires, as evidenced by these test results on 6" tees:

| | BURSTING PRESSURE | |
|---|---|---|
| Schedule | ASA B16.9 Required | Test Minimum |
| 40 | 4440 psi | 5950 psi |
| 80 | 6845 psi | 8625 psi |

*Result of typical hydrostatic bursting test conducted in the Tube Turns research laboratory. The pipe itself split wide open under the terrific pressure applied; the new Tube-Turn welding tee is undamaged. Micrometer checks reveal no evidence of yielding or distortion.*

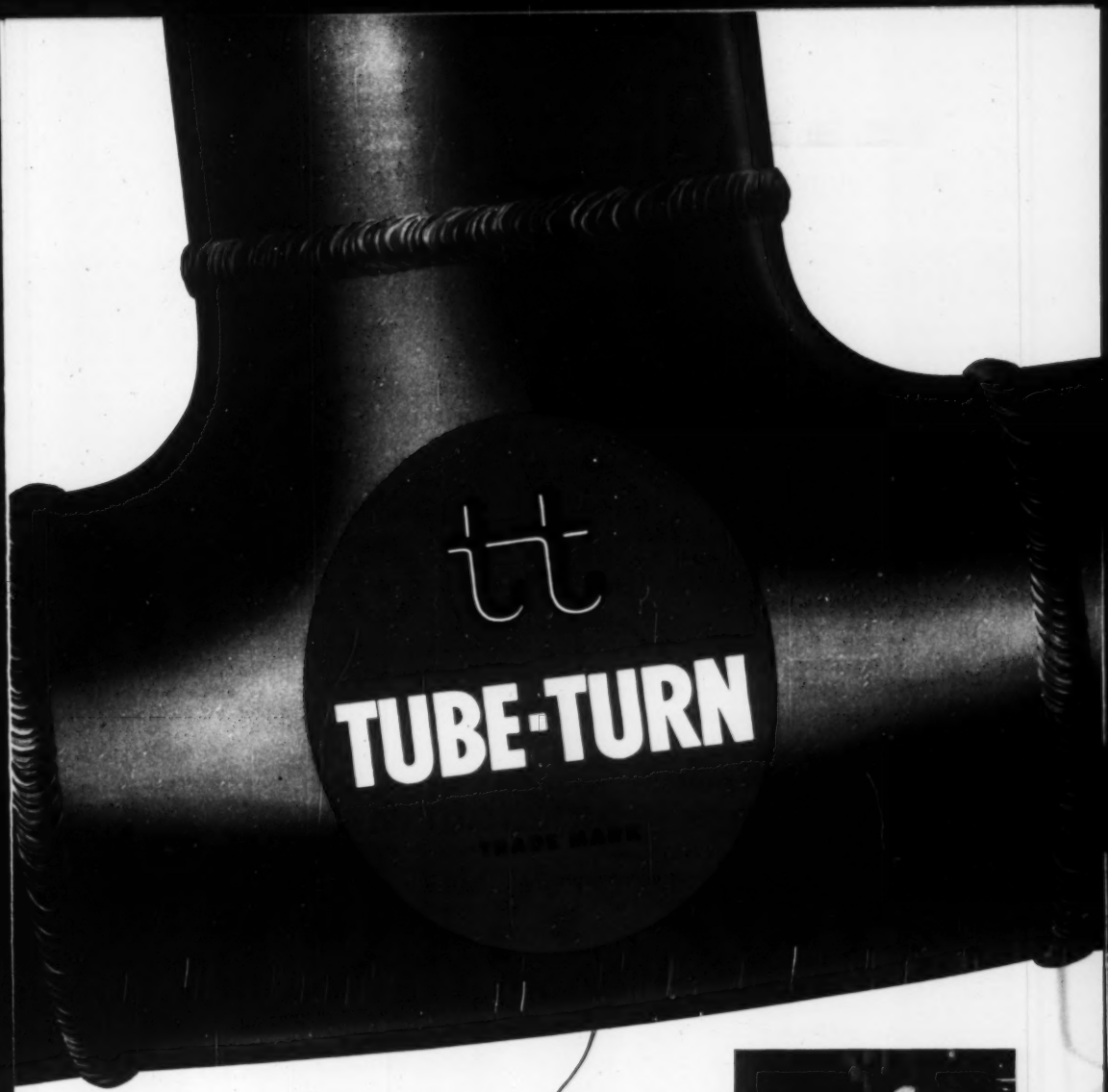
### FREE BOOKLET

Write for your free copy of "Research", a booklet reporting results of cyclic tests being conducted by Tube Turns engineers on the fatigue life of piping assemblies. Well illustrated. Contains valuable information on relative fatigue life of welding elbows, mitre bends, various types of flanges.

"Be Sure You See The Double tt"

**TUBE TURNS, INC.**

LOUISVILLE 1, KENTUCKY




*In all the world there's only one TUBE-TURN Welding Fitting as shown by this trade mark... the right mark for every need in welding fittings and flanges.*

*Your nearby TUBE TURNS distributor can serve you right from stock. Call him for prompt delivery.*

**TUBE TURNS, INC., LOUISVILLE 1, KENTUCKY** DISTRIBUTORS IN ALL PRINCIPAL CITIES

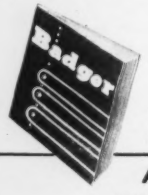
DISTRICT OFFICES: NEW YORK • PHILADELPHIA • PITTSBURGH • CHICAGO • HOUSTON • TULSA • SAN FRANCISCO • LOS ANGELES

*In Canada . . . Tube Turns of Canada Limited, Chatham, Ontario*

# When the fit's tight you're glad it's a **Badger** Joint

Large unwieldy fittings have no place in the complicated pipe line layouts used today. Badger Directed Flexing Packless Corrugated Expansion Joints, thoughtfully designed to give the utmost in performance yet use a minimum of space, cause no installation problems. Outside diameter of the expansion joint is little more than outside diameter of a flanged pipe fitting.

Take a tip from the leaders in every field where piping is a problem — save space and get top performance by specifying Badger Directed Flexing Packless Corrugated Expansion Joints.




*Fresh from the press!*

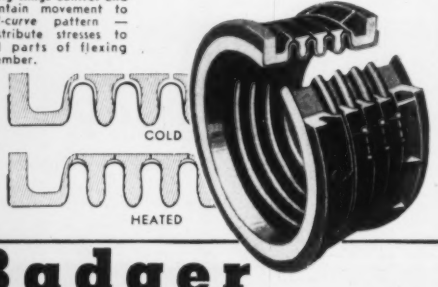
. . . Badger Manufacturing Company's new 24-page catalog is ready. Send for your copy today.

**All-curve flexing guarantees longer life**

**Badger Joints flex like this . . .**

**not like this . . .**

EXCLUSIVE construction of Badger Joints eliminates localized flexing stresses that cause breakdowns. Directed Flexing Equalizing Rings control and contain movement to *all-curve* pattern — distribute stresses to all parts of flexing member.




**Badger**

**MANUFACTURING COMPANY**

**230-260 BENT STREET CAMBRIDGE 41, MASS.**


are "Everdur" welded. The coils are arranged for flooded operation with high or low pressure float control or liquid refrigerant pump recirculation. Low pressure receivers have external float control. Cooling coils are spiral fin pipe, continuous, and hot dipped galvanized after fabrication. A water or brine defrosting arrangement may be furnished when required. The fan section consists of multiple centrifugal fans mounted on a common shaft which is v belt driven by a single motor. Bearings are of the self aligning pillow block type with graphite bronze bushings and external oil cups.

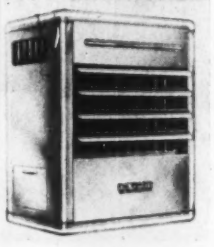
**HPAC 4358—CORROSION RESISTANT PIPE**—For 15 years "Yoloy" steel has been manufactured as seamless pipe, sheets, plates, and structural members. This nickel-copper, low alloy steel is now available as continuous weld pipe from Youngstown Sheet and Tube Co., Youngstown 1, Ohio.

Outstanding characteristics are said to include excellent corrosion resistance, ease of welding, ease of bending and fabrication, high tensile strength and resistance to abrasion, shock, and vibration.

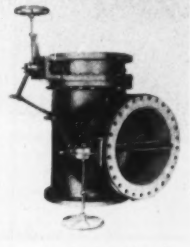
Its atmospheric corrosion resistance is said to be from four to six times that of regular carbon steels, and its resistance to many other corrosive elements, says the manufacturer, makes it well adapted for numerous industrial uses.

**HPAC 4359—GAS FIRED UNIT HEATER**—Reznor Mfg. Co., Mercer, Pa., has redesigned its line of gas fired unit heaters.

Features of these self contained, fully automatic units are said to include easy accessibility for quick servicing, compact design, and "Perlite" finish, a gray-green metallic paint which provides an unusually heavy protective coating.



Unit Heater



Rubber Seated Valve

**HPAC 4360—RUBBER SEATED VALVES**—Now available from R-S Products Corp., Wayne Junction, Philadelphia 44, are two rubber seated, butterfly type valves which can be operated in unison and which have rubber seats designed to withstand temperatures from —40 F to 275 F. Previous temperature limitations of the rubber were from —20 F to 180 F.

Said to be drip tight with water at 100 psi and air bubble tight at 80 psi, the two No. 733 30 in. valves shown here are attached to a 30 in. tee and are provided with handwheel controls with declutching mechanisms and outboard gooseneck bearings.

Glasfloss Air Filters hold more dust at higher efficiency with less resistance to air because the filter pad is made of incredibly fine glass fibres. Fibres as fine as human hair are assembled in a fluffy, resilient mass with an intricate maze of air passages. The long, curly glass fibres provide greater surface area so that Glasfloss air filters actually stop more dust while allowing free air circulation.

## Glasfloss Air Filters meet every need!

**STANDARD DISPOSABLE TYPE.** Glasfloss Air Filters are made for all types of central heating, ventilating, and air conditioning systems. The standard disposable type in the chipboard frame is supplied in all standard sizes for use both in home heating equipment and in commercial or industrial filter banks. The light, fluffy texture of the filter pad permits maximum penetration of dirt without clogging the pad and imposing extra loads on the equipment.

**REFILL TYPE IN REUSABLE METAL FRAMES.** For large industrial filter banks the Glasfloss refill type air filter effects considerable economies—as much as 30% of standard filter replacement costs! The lightweight reusable metal frames are easily refilled with fresh pads because the pads are as fine and soft as silk. With the Glasfloss refill type filter, there is no longer any economy in re-processing dirty pads for re-use—the fresh, clean new refills cost so little!

**BOTH TYPES GIVE BETTER AND MORE ECONOMICAL FILTERING PERFORMANCE THROUGH THE USE OF LONG, FINE GLASS FIBRES**

Once you see the light, fluffy texture of the Glasfloss filter element, you will see why Glasfloss air filters last longer, hold more dirt. Send for complete information. Address Dept. HP.

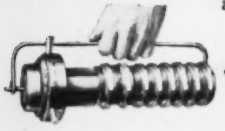
Glasfloss 155 EAST 44th STREET, NEW YORK 17, N. Y.

# *Extra-Easy Threading*
## OF SHORT NIPPLES

"This RIDGID nipple chuck sure cuts the monkey-business out of threading short nipples."

**New RIDGID Nipple Chuck fits any threading machine, power drive or vise**

● Typical RIDGID worksaver advantages in this new nipple chuck—to speed every short nipple threading job! Fits any threading machine, power drive or vise—no special tools, parts or adjustments. No adjusting or changing of stop plug—it's an integral part of nipple chuck—automatically in position for use. Threading nipple is released instantly by turn of nipple chuck—easily unscrewed by hand. Pipe adaptors for ¼" to 1½", chuck takes 2" pipe. Ask for this new efficient nipple chuck at your Supply House.



*FREE Patented Carrier for any set*

**RIDGID**
**WORK-SAVER PIPE TOOLS**
**THE RIDGE TOOL CO. • ELYRIA, OHIO**


The valves can be operated individually, in unison, or may be adapted to automatic control. They can be used for mixing purposes, as a reversing valve on condenser water, and for other applications.

**HPAC 4361—COOLING TOWERS**—Model UT induced draft cooling towers are now available from Baltimore Aircoil Co., Inc., 715-17 W. Pratt St., Baltimore 1. They are offered in capacities from 7½ to 100 tons of refrigeration, the ratings being based on 3 gpm of water circulated per ton with 78 deg wet bulb temperature and 95 deg water on and 85 deg water off the tower.

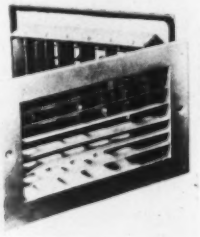
Towers are of galvanized casing construction and feature metal wet decks. According to the company, they are designed for flexibility of installation and ease of maintenance. The standard tower is suitable for either indoor or outdoor service.

**HPAC 4362—FLOWMETER AND CONTROLLER**—The "Veriflow" meter of Hays Corp., Michigan City, Ind., is now available for indicating the rate of flow of corrosive liquids, including a variety of acids, hydroxides, etc.

Measurement is volumetric. Each complete movement of the measuring piston displaces a fixed volume of liquid which enters the inlet port and fills the spaces above and below the piston. The volume of liquid flowing causes the piston to move. This movement is transmitted to the drive shaft which passes through a stuffing box to a direct connected generator. The indicator, which may be remotely mounted, measures the generator output and is calibrated to indicate rate of flow.

The "Veritrol" consists of the flow meter plus automatic control equipment. The output of the meter generator is used to position a control valve which regulates flow until the generator output balances a potentiometer circuit at the desired rate of flow.

Flowmeter

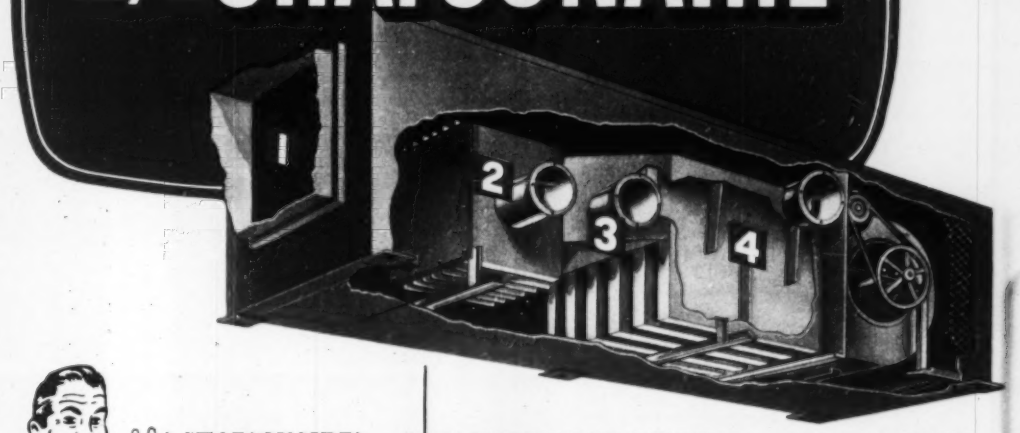


Air Grille

**HPAC 4363—AIR GRILLE AND VOLUME CONTROLLER**—Titus Mfg. Corp., Waterloo, Iowa, has introduced a new combination air grille and volume controller. Two sets of "Airfoil" louvers are used to control volume and distribution.

According to the manufacturer, the device is economical, light, easy to carry and install, and has few parts. An unusual feature is said to be the speed with which adjustments may be made.

# FOUR ESSENTIAL FEATURES found only in SHAFCONAIRE*



**SHAFCONAIRE!** It's the *original* overhead furnace known for years as SHAFCO. And it's the only furnace of its type that has been time-tested, proved-in-use over 12 long years of actual field operation. That's of prime importance to you, too. Because, regardless of a manufacturer's claims and written guarantees, time . . . and time alone . . . offers the only positive proof of the merits of any product. It's your one best assurance of quality, performance, and dependability.

So take a good look at SHAFCONAIRE OVER-HEAD HEATERS. Look under the casing . . . at the all-important inside furnace construction details. See for yourself the exclusive, essential, patented features that have made SHAFCONAIRE the leader of its field, the outstanding quality "buy" on the market today!

**1** **BUILT-IN PLENUM CHAMBER**—This exclusive patented SHAFCONAIRE feature saves you plenty of time and trouble in making installations. It's engineered and sized to handle capacity of the furnace. Assures uniformly heated warm air output, improves operating efficiency, reduces installation costs. Eliminates necessity of on-the-job sizing and extra sheet metal work. Ducts may be quickly, easily tapped off from end, top, and both sides to meet installation requirements.

**2** **HEAVY DUTY FURNACE**—Use of heavy gauge welded boiler plate construction assures long-life, trouble-free performance. No strains, no warping, no buckling. No burn-outs common to stamped steel fabrication.

**3** **INTERMEDIATE HEAT-TRAVEL SECTION**—Patented intermediate chamber between refractory-line firebox and heavy gauge heat exchangers serves to spread flame, permit expansion of hot gases. Effectively prevents impingement of flame on metal, increases life and overall operating efficiency of the furnace.

**4** **EFFICIENCY ENGINEERED HEAT EXCHANGER**—Alternately spaced baffle plates in each heat exchanger section effectively retards flow of hot gases toward stack connection, permits maximum transfer of heat through the exchanger.

## OVERHEAD HEATERS, INC.

*(Formerly SHAFCO Distributing Corporation)*

1354 BOOK BUILDING • DETROIT 26, MICHIGAN

**OVERHEAD HEATERS, INC.**
1354 Book Building • Detroit 26, Michigan

**Please send me complete information and price lists on your SHAFCONAIRE (formerly SHAFCO) OverHead Heaters.**

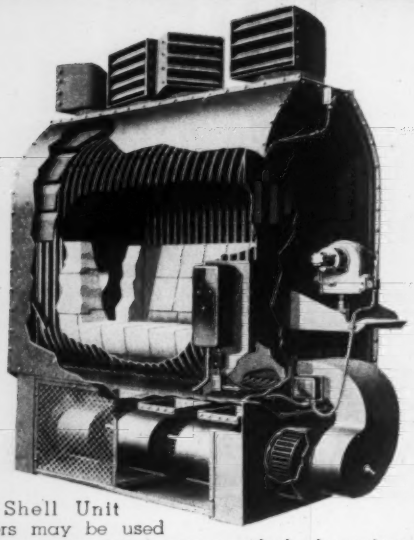
*Name*_____

*Address*_____

*City*_____ *Zone*____ *State*_____

*SHAFCONAIRE, the original overhead furnace formerly known as SHAFCO. Designed, engineered, and built exclusively for commercial and industrial applications. Models from 100,000 to 405,000 B.T.U. Backed by over 12 years actual operation in the field. Send in coupon today for complete details and price information.

LEE SHELL UNIT HEATER



Lee Shell Unit Heaters may be used singly or as a central system with the heated air distributed through ducts.
The efficiency of Lee Counter-current flow reduces fuel consumption while the rugged simplicity of the system decreases cost of installation, assures low maintenance charges and provides ventilation without additional cost.

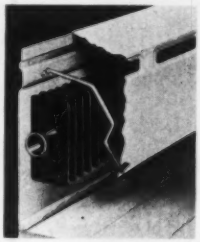
The LEE line . . .
Steel Encased Tubular Heater
Tubular Unit Heater
Brick-Set Tubular Heater
Shell Unit Heater
Write now for more information

LEE ENGINEERING CO.
95 RIVER ST. HOBOKEN, N. J.

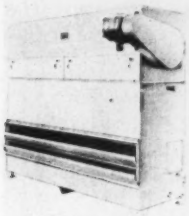
**HPAC 4364—BASEBOARD RADIATION HANGER**—Vulcan Radiator Co., Hartford, Conn., is producing a new rod hanger designed to speed installation of its baseboard unit by suspending radiation directly from the backing which is an integral part of the installation.

It is designed to eliminate the spotting and drilling of holes and insertions of screws. Knockouts in the backing are punched out on the job as required. The hanger is inserted, pushed down between fins, and a quick-fastening nut is pushed up snug against the bottom of the fins. One of the outstanding features, says the firm, is that it provides for easy adjustment of pitch of the radiation with ample allowance for expansion.

Made in two sizes, 1 and 1¼ in., the hanger can be used for nonrecessed or semi-recessed installations.



Baseboard Radiation



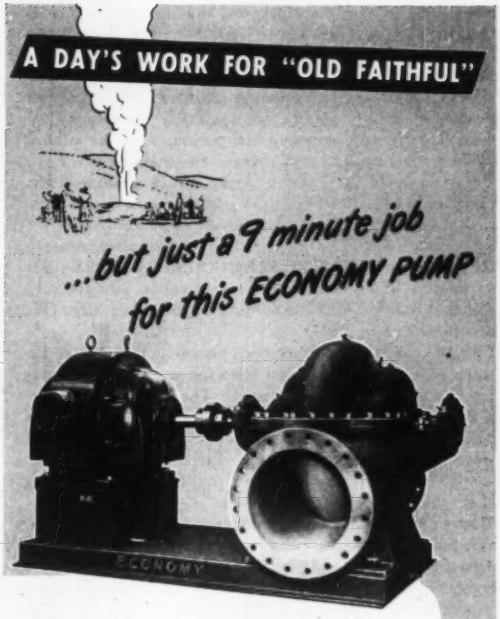
Cooling Tower

**HPAC 4365*—COOLING TOWERS**—A new line of induced draft cooling towers in capacities from 3 to 75 tons of refrigeration is offered by Bush Mfg. Co., West Hartford 10, Conn.

Nominal capacities are based on 3 gpm of water per ton, entering and leaving condenser water temperatures of 95 F, and 85 F respectively, and 78 deg design entering wet bulb temperature. The wetted deck surface is constructed of 24 ga galvanized iron with a zinc chromate finish. Eliminator sections are of glass fiber matting, and double inlet centrifugal fans are used. The brass and copper spray header assembly includes removable spray nozzles of the centrifugal type.

**HPAC 4366*—UNDERGROUND CONDUIT SYSTEM**—Whatley Steam Systems, 101½ Stratford, Houston 6, Tex., has developed a new underground conduit system for pipe lines carrying steam, condensate, and other heated fluids. It is said to be especially suitable for central plant systems and may be used with single pipe lines or several lines and in "extremely bad soil or water conditions".

The system consists of a steel pipe (the size and type being determined by operating conditions) supported at regular intervals by circular refractory supports. The support is a castable refractory with an imbedded steel plate which is designed to fit, with suitable tolerance, the size of pipe used. The support is slipped on and spot welded to the pipe which is then coated with rust inhibiting paint. The annular spaces around the spot welds are filled with a damp mixture of insulating cement. Sectional molded insulation, with an impregnated asbestos felt jacket is applied, the jacket sealed in place, and the insulation given a waterproof coating. An outside casing of compressed cement-asbestos construction, which utilizes couplings and gaskets, is slipped on over the insulation and supports.




Erupting every 65.6 minutes, Old Faithful spouts a quarter-million gallons per day in an impressive display of Nature's "pumping" power. The same volume of water can be delivered in less than 9 minutes by an ECONOMY Double Suction Pump.

From 50 to 30,000 gallons per minute, there are more than 1500 Ratings of this Economy Double Suction Pump . . . to meet your requirements for any capacity at heads to 300 feet. Designed for general purpose pumping of clear liquids at moderate heads, these single stage units are suited to general water supply or heavy mill service.

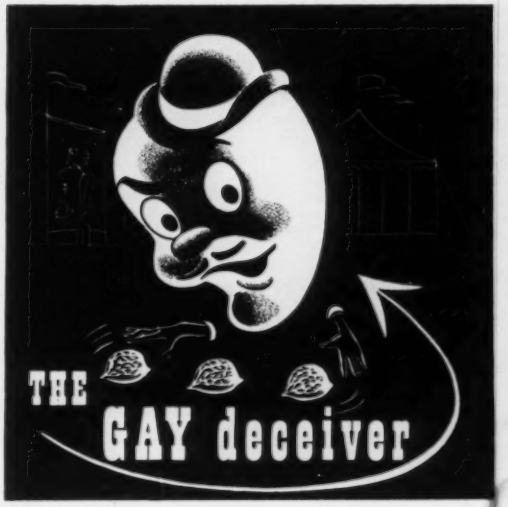
Sound hydraulic design give these Economy Pumps a broad, flat efficiency curve over a wide capacity range. Minimum maintenance is assured by sound engineering—based on such advantages as:

- Easy removal of complete rotor without exposing bearings.
- No leakage between sleeve and shaft . . . shaft sleeves are sealed.
- Flanged wearing rings, "L" shaped, inward flow.
- Unusually effective water seals.
- Large wells for lubrication.

If you wish full details, our Dept. C-5, will gladly send you Catalog A-1147.

**Economy Pumps Inc.**

DIVISION OF HAMILTON THOMAS CORP. HAMILTON, OHIO




Don't be fooled by power-laden Btu's that escape from improperly insulated or uninsulated heated equipment. Such shenanigans represent an expensive luxury which no plant can afford.

Check power losses, cut production costs, raise efficiency. Be sure your heated equipment is protected by efficient, low-cost **CAREY Industrial Insulation!**

*And here's a new product to keep Btu's on the job . . .*

CAREY TEMPCHEK

a specialized material with a temperature range up to 1500° F., low K factor, rugged strength, excellent "Handle-ability"—

*it's a combination of outstanding qualities . . .* ***Ask about it!***

Call your CAREY representative today. He's a trained expert who is eager to serve you.

**CAREY Makes the Complete Line!**

**85% Magnesia—Industrial Rock Wool—Asbestos—Pipe Coverings—Sheets—Blocks—Batts—Papers—Air-Cell.**

Write for your free copy of "Heat Insulation For Industry." Address your request to Dept. H-5. The Philip Carey Manufacturing Company, Cincinnati 16, Ohio. In Canada: The Philip Carey Company, Ltd., 1557 MacKay Street, Montreal 25, P. Q.

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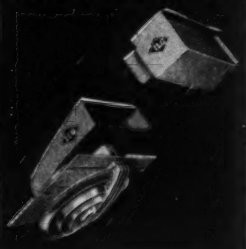
*World's most complete line of*
**ELECTRIC VENTILATORS**

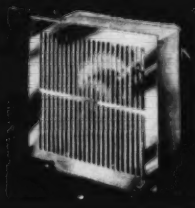


**New Ceiling Type**

Easily installed *anywhere* in kitchen. Fully automatic operation from wall switch. Large capacity without sacrificing super-quiet operation. Popular 10″ size.

**"Built-in" Wall Type**

For installation in *any* outside wall. Either fully automatic or "pull-chain" operation. Easily installed. 8″, 10″ and 12″ sizes.



**Package Type**

For window pane or thin wall installation. "Pull-chain" operation. Large capacity . . . smooth running . . . super-quiet. 8″ and 10″ sizes.

**Panel Type**

For quick, easy installation in window frame. Requires just four screws and a few minutes work. 8″, 10″ and 12″ sizes.

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☐ Please send me FREE data on your complete line of Electric Ventilators.

*Firm Name*_____

*Executive's Name*_____ *Title*_____

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*City*_____ *State*_____

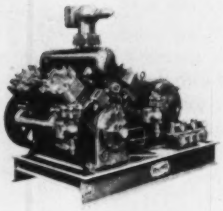
According to the manufacturer, the pipe support will withstand temperatures up to 2700 F and is impervious to the action of any water which may collect in the outside casing. At each quadrant or 90 deg point on the support, a semi-circular opening is provided, the bottom one serving as a drain for condensation which may be formed during the warming up period, and the others providing air passage ways around the insulation.

Advantages of the casing are said to include light weight and ease of handling, water tightness, and corrosion resistance.

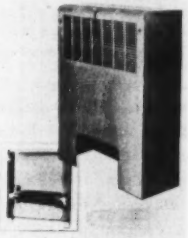
**HPAC 4367—REFRIGERATION COMPRESSORS**—Six new models of eight-cylinder refrigeration compressors (type R-75) have been developed by Brunner Mfg. Co., Utica 1, N. Y.

Compressor, motor, and bed plate combinations are available in 50, 60 and 75 hp sizes for use with evaporative or water cooled condensers. The compressor is of the 90 deg v type with two cylinders to a block. Both blocks and crankcase are of special analysis cast iron. Throws are arranged so that a discharge stroke occurs every 45 deg. This, says the firm, makes for easy starting and smoothes out power impulses.

Both suction and discharge valves are of the reed type. Unloaded starting and capacity control equipment is optional. The four step capacity control can be made responsive to suction pressure, space temperature, damper position, etc. All units are bolted to a mounting base of welded structural steel.



Refrigerant Compressor



Convector

**HPAC 4368* — CONVECTOR RADIATOR** — Brown Products Co., Forest Hills, N. Y., has developed a new "Tu-Way" convector of the cabinet type for both recessed and free standing installations.

The heating element is of copper tubing and fins are of aluminum. According to the company, the unit is designed for maximum efficiency and small floor space.

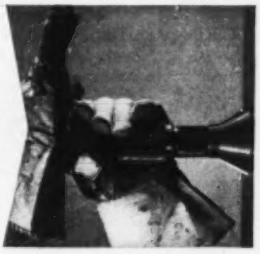
**HPAC 4369 — AIR CONDITIONING CONTROL VALVE**—A patent covering a reversible regulating valve for year-around air conditioning systems has been awarded to R. U. Berry of the air conditioning department, General Electric Co., Bloomfield, N. J.

The valve system is designed for air conditioning installations which are equipped with full automatic year-around control where the changeover from heating to cooling, and vice versa, will be accomplished by reversing the direction of flow. The system is designed to permit occupants to adjust the thermostats for any temperature desired, either heating or cooling, without limitation by a fixed differential between heating and cooling.

# READY!

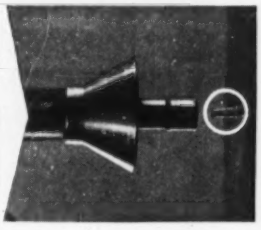
Takes less than 30 seconds to prepare RAMSET TOOL with power charge and choice of 65 coated steel fasteners.

# RAM!



Place light, compact tool against work, locating fastening point as accurately as desired. Then tap lightly and the fastener is . . .

# SET!



Instantly, tightly, cleanly, easily. No drilling, chipping or plugging. Less than a minute from start to finish.

## Fast . . . reliable *RAMSET SYSTEM* slashes costs . . . and time . . . for fastening into steel and concrete

Every day, thousands of users are making startling economies in money and time with RAMSET FASTENING SYSTEM. For practically any kind of fastening jobs into steel, concrete, masonry, RAMSET does the work faster, better, cheaper.

Let us show you, by comparison with ordinary methods, how you can cut costs up to 60% and do your fastening work in 1/5 the time with the modern, reliable, proved RAMSET SYSTEM. Send for details and address of nearest RAMSET Specialist.

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individually REGISTERED and completely GUARANTEED

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**Special**
**Money-Back Trial Offer!**

Buy one "Registered" Roxco and use it for your toughest jobs. If you don't agree it stands up better . . . is handier, faster to use . . . is a bigger value than any pipe wrench you've ever used . . . return that one trial Roxco direct to us (not the seller), within sixty days with a note of price paid and reason for returning. We will refund your money. This get-acquainted offer good until Dec. 31, 1950.

## ✓ *Check these "engineered" features*

1. **Extra Strength** from extra metal put at critical points . . . withstands heavy "side pull" . . . saves costly failure.
2. **Lighter, Handier** because useless metal is eliminated.
3. **Stronger Jaws** of drop-forged alloy steel, with induction hardened teeth but a tough core.
4. **Reinforcing Shoulder Behind Jaw** resists unusual stress.
5. **Rapid Ratcheting Action** — New cushion action, with tooth design, avoids seizure and permits fast work. Parts fit accurately — less lost motion.
6. **Wide, Palm-fitting Handle** makes work easier, cuts worker fatigue.
7. **Reinforced Housing** embodies hammer face to break cast fittings.
8. **Handy, Accurate Pipe Scale** permits quick adjustment to size.

**Special Metallurgical Formula**— Roxco Metal, and scientific heat treating, mean superior strength in housing and handle.

**A Brute for Strength . . . A Beauty to Handle!** Now you need not tolerate useless weight in order to get a dependably strong pipe wrench. Through stress analysis during design, useless metal that means tiring weight was engineered out of the new *Roxco*. Extra metal, exactly where needed for extra strength, was engineered in!

The lighter, handier, faster-working *Roxco* actually exceeds strength requirements of Federal Specifications for Heavy Duty Pipe Wrenches, Type II, GGG-W-651a. Scientific design, special alloy metal and careful quality-control enable us to register every *Roxco* by serial number and guarantee *every* part of it against breakage in any normal heavy duty use! Made in sizes from 6 in. to 48 in. Write for folder and names of local suppliers.

**TRIMO-ALLOY WRENCH** . . . Roxco's only Rival . . . is an all alloy-steel heavy duty pipe wrench long famous for ruggedness. Different in design, but has power comparable to Roxco.

**TRIMONT MANUFACTURING CO.**
Division of Aetna Industrial Corporation
**55 Amory Street, Roxbury 19, Mass.**
Makers of Wrenches, Pipe Cutters, Vises and Other Trimo Time-Tested Tools

# WEBSTER KINETIC* GAS BURNER

- Designed for LOW GAS PRESSURE
- Will Operate at ONE POUND
- Will TURN DOWN to ½" Water
- Fires a SCOTCH MARINE BOILER without a dutch oven or refractory lining
- Will operate through a FIRE DOOR
- Will NOT VIBRATE
- Draft Loss VERY LOW
- This Gas Burner is available in ANY SHAPE and SIZE
- INTEGRALLY MOUNTED pilots

*For WEBSTER KINETIC BURNER Information Write—*

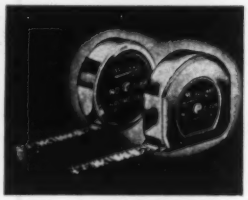
**THE WEBSTER ENGINEERING COMPANY**

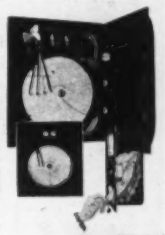
**P.O. Box 2168—Tulsa, Oklahoma**

**Trade Mark*


**HPAC 4370—STEEL TAPE RULES**—The "Mezurall" and "Wizard Jr." steel tape rules now have "Chrome-clad" satin finish blades designed to absorb disturbing light reflections and afford easier reading of all markings and graduations. The black markings, according to Lufkin Rule Co., Saginaw, Mich., stand out sharply against the hard, smooth chrome-white surface and are durable, permanently bonded to the steel, and sunk below the surface.

The blade is manually operated out of and into the case. Balanced construction is said to hold it at any length withdrawn and the blade is held in the case by a stop catch guarding against breakage when not in use. In addition, blades are replaceable and have a detaching device that permits quick replacement. New plated cases of an improved design have flush inset side plates.





*Above:* Steel Tape Rules
*Right:* Recorder

**HPAC 4371—RECORDING INSTRUMENTS**—Penn Industrial Instrument Corp., 3116 N. 17th St., Philadelphia 32, has developed a new and amplified line of pressure and temperature recorders.

Temperature measurement by the self-actuated tube systems of the gas-filled, vapor tension and liquid-filled types for ranges from —100 F to 800 F are offered. The Bourdon springs used are said to be unusually sturdy and emphasis is placed on accurate calibration and long aging of each element.

The new case design accommodates up to four pens (any combination of temperature and pressure). Storage space is provided within the case for 200 charts and four bottles of ink.

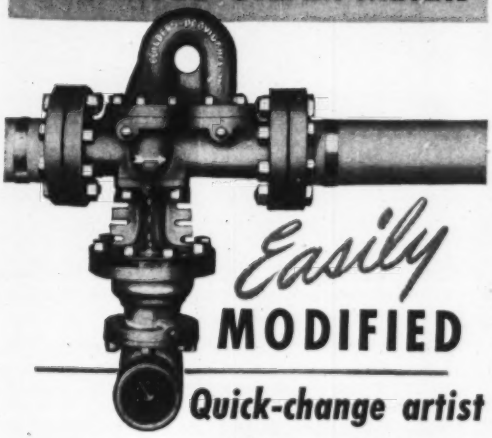
**HPAC 4372—GEAR MOTORS**—Foote Bros. Gear and Machine Corp., Chicago, and The Louis Allis Co., 427 E. Stewart St., Milwaukee 7, have recently announced a joint program for the manufacture and sale of a complete line of gearmotors.

The new unit makes use of hard helical gears and other moving parts which have been processed and heat treated under new and improved methods of manufacturing control. These methods are said to have produced unusual standards of performance with regard to load carrying capacity, wear life, quietness of operation, and compactness of design.

The new gearmotor, manufactured in 17 sizes, is offered in single, double and triple reduction units having output speeds from 780 rpm down to 7.5 rpm. Integral horsepower ratings from 1 through 75 hp are available for practically any industrial application.

A wide selection of motor enclosures is offered, including open drip-proof, splashproof, totally enclosed and explosionproof construction. A-C and D-C motors of all

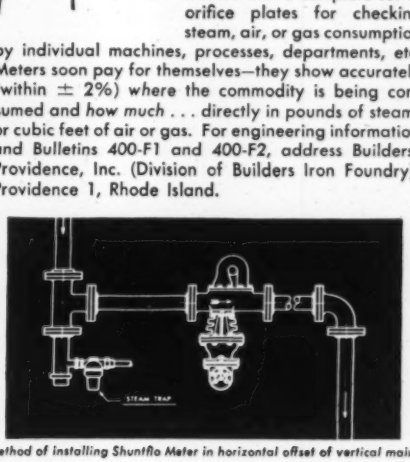
# ANOTHER IMPORTANT FEATURE OF SHUNTFLO STEAM METER



## Easily MODIFIED

### Quick-change artist

**Builders Shuntflo Steam Meter** is easily modified for change in capacity. Simply remove the top cover, install a new orifice plate, and replace the cover . . . that's how easy it is to change from one capacity range to another. Many companies buy Shuntflo Meters with a complete set of orifice plates for checking steam, air, or gas consumption by individual machines, processes, departments, etc. Meters soon pay for themselves—they show accurately (within ± 2%) *where* the commodity is being consumed and *how much* . . . directly in pounds of steam, or cubic feet of air or gas. For engineering information and Bulletins 400-F1 and 400-F2, address Builders-Providence, Inc. (Division of Builders Iron Foundry), Providence 1, Rhode Island.

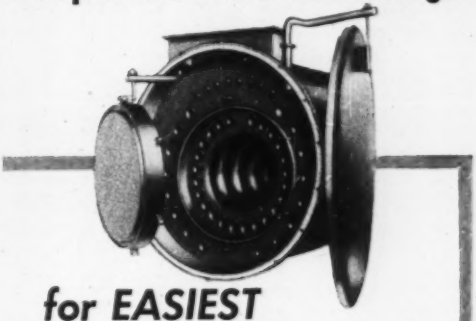



*Method of installing Shuntflo Meter in horizontal offset of vertical main*

Builders makes a complete line of flow meters and controllers for liquids, steam, air, gas, and dry materials . . . mechanical and differential . . . including The Venturi Meter and Chlorinizers (chlorine gas feeders).

**BUILDERS PROVIDENCE** *Instruments*

# AMESTEAM GENERATOR provides simplified rear end design



## for EASIEST

- Inspection
- Maintenance
- Cleaning

**AMESTEAM Generator design provides a better automatic Unit—soundly engineered to meet your needs.**

**With this simplified rear end design it is a minor operation to completely expose furnace and all tubes. Open rear flue cover—it's in one piece instead of several panels. Open rear baffle—of sturdy one-piece construction instead of numerous special refractory shapes. The baffle refractory is easy-to-get, cold-set plastic-type instead of expensive special shapes which must be ordered from the manufacturer. Flue covers and baffle are on davit-type hinges, Sizes A-50 and larger, making them easy to open in limited space.**

**That's only one of AMESTEAM Generator's many advantages. Auxiliary equipment is completely accessible —controls are properly positioned—all for your ease and convenience—and to save you time and money.**

**It all adds up to the easiest boiler to operate, inspect, maintain and clean—and it generates steam quickly, efficiently and at low cost.**

*Sizes 10 to 500 HP — 15 to 200 lbs. — arranged for oil, gas or oil-gas combinations.*

Before you buy, learn ALL the exclusive features of the fully automatic AMESTEAM Generator. Mail coupon below for your free copy of our latest bulletin.

## AMES IRON WORKS

**Oswego, N. Y.**

Builders of Better Boilers since 1848
Manufactured under license in Canada by VOLCANO, Ltd., Montreal, P. Q.

*Choice franchises still available, write us.*

**Ames Iron Works, Box 2005, Oswego, N. Y.**

**Please send me your new free bulletin of Amesteam Generators.**

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HOW TO SAVE UP TO
$5,000
ON AIR CONDITIONING

PAT. NO. 2,297,928

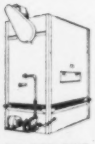
GOVERNAIR
COMPLETELY PACKAGED
AIR CONDITIONER

Save water! Save space! Save installation time and money! Save operating costs! Yes, install Governair and *save from $50 to $200 for each ton* of the completely packaged Governair unit designed to fit your needs!

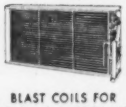
Experience proves Governair can save you up to $5,000 on a 50-ton Governair unit that gives greater dependability and more "engineered efficiency" than ever before!

If you want the best — if you want the most economical and reliable air-conditioning unit on the market . . . CHOOSE GOVERNAIR and SAVE!

AIR CONDITIONERS



EVAPORATIVE CONDENSERS



BLAST COILS FOR HEATING & COOLING

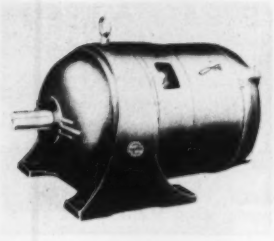
ORIGINATORS OF COMPLETELY PACKAGED AIR CONDITIONERS

GOVERNAIR

UNIT COOLERS

GOVERNAIR CORPORATION • 513 N. BLACKWELDER • OKLA. CITY

types, as well as motors having special electrical characteristics, are available to meet unusual installation and application requirements.



Gearmotor

Hand Torch

**HPAC 4373 — HAND TORCH** — Pressure Products Corp., 140 N. Dearborn St., Chicago 2, has developed a new "Prepo" hand torch which is especially recommended for use in soldering copper tubing and copper pipe.

The liquid fuel is a special compound of hydrocarbons which is self pressurizing and self vaporizing. To ignite the burner, a valve is turned and a match is applied. Heat, in the form of a blue flame at 2200 F, is delivered instantly. Two burner tips are furnished, the larger one providing a broad flame and the smaller one throwing a long, narrow flame for use where the heat must be concentrated in a small area. Weighing 1½ lb, the unit has a throw-away type fuel container which may be replaced in 30 sec.

Available from most pipe fitting supply jobbers, the torch and the fuel are being distributed by Bell & Gossett Co., Morton Grove, Ill.

**HPAC 4374—AIR FILTER GAGE**—The "Visi-Float" air filter gage of F. W. Dwyer Mfg. Co., 317 S. Western Ave., Chicago 12, has been developed for use with air conditioning units, window ventilators, and forced warm air heating systems. It is said to be a simple device for quickly determining the condition of air filters.

It is used to measure the pressure differential across the filter. A float rises in the transparent gage glass as the pressure drop across the filter increases. A red mark on the gage is used to indicate the necessity for filter replacement.

The body is of molded plastic and the gage is furnished with all necessary parts for installation. It is mounted on the upstream side of the filter and on the outside of the furnace or conditioner. A plastic tube is extended into the blower chamber through the filter or filter frame.

## WE HEAR THAT • • • •

**Westinghouse Electric Corp.**, Pittsburgh, has extended its equity plan for financing purchases of company products through local banks to include distributor and dealer inventory and display stocks of air conditioning equipment. Under the plan, the company agrees to repurchase any merchandise which may be repossessed.

## THE LOWDOWN ON INSULATION

# How to lick a phantom

You can't see water vapor. But you can't ignore it, either. If vapor ever gets into your cold room insulation, it multiplies your power costs, ices up, makes walls bulge and break, leads to costly repairs.

To lick vapor, you need two things. First, an insulation material that inherently resists moisture, such as Novoid Corkboard. Second, a material on which you can apply a strong and lasting vapor seal.

To seal Novoid Corkboard, you simply dip each board in melted asphalt before putting it in place. No need for elaborate technique; nothing to puncture or tear.

Novoid Corkboard is American-made, under the strictest quality control. And it's installed by some of the most experienced, dependable men in the business. About the best way to keep refrigeration costs down, is to insulate in the first place with Novoid Corkboard and Novoid Cork Covering for pipes and fittings. If conflicting insulation claims confuse you, just write to us. We'll be glad to send you the "lowdown." Novoid Cork, Englewood, N. J.

**Consider EVERY factor when you buy insulation—and you'll buy NOVOID**

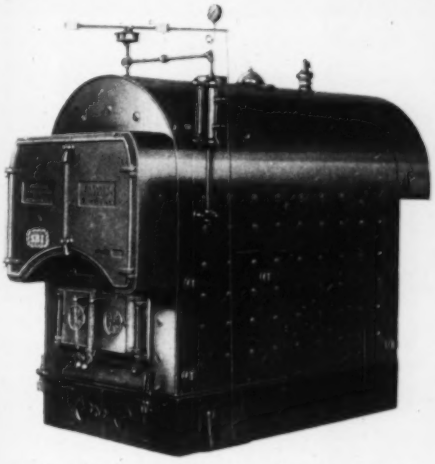
**Check list of insulation properties**

| | Novoid Cork Insulation | Many Other Insulations |
|---|---|---|
| First cost | moderate | low to high |
| Installation cost | low | moderate to expensive |
| Eventual cost | low | high |
| Efficiency | remains high | generally deteriorates |
| Moisture resistance | excellent | some good, some poor |
| Vapor seal | simple | complicated or difficult to install |
| Structural strength | very good | some non-existent, others fair |
| Weight | very light | varies |
| Resilience | considerable | from fair to complete rigidity |
| Settling | none | a serious problem |
| Supporting structure | none | elaborate |
| Fire resistance | good | excellent to poor |
| Vermin resistance | good | excellent to very bad |
| Odor absorption | none | some are regular sponges |

BURNHAM

# COMPACT TYPE

## WELDED STEEL BOILERS



*Large capacity in less space*

Take advantage of Burnham's long experience in building fine steel boilers. Here's quality and efficiency you can depend on. Burnham steel boilers are giving a good account of themselves in schools, apartment houses, churches and greenhouses all over the country.

**Capacities range from 3,000 to 35,000 square feet.**

The famous Burnham fire travel, 3 times back and forth the length of the boiler, scrubs maximum heat from the fire. Quick steaming without priming. Low water line—easily installed. Adaptable for all fuels. Can be equipped with tankless or storage type hot water coils.

Built in strict accord with ASME Code. Ratings conform to SBI Code.

*Burnham Corporation*

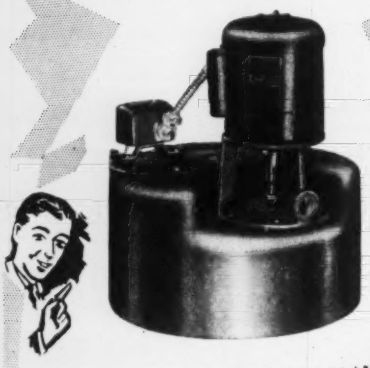
"PIONEERS OF RADIANT BASEBOARD HEATING"

**IRVINGTON, N. Y.**

MAIL coupon today for folder SB-103 containing full details, ratings and installation data.

Burnham Corporation Dept. HP-50
Irvington, N. Y.
Please send me Folder SB-103 on Compact Steel Boilers.
Name .....
Address .....
City ..... State .....

# Pump Points
## ...that mean PERFORMANCE




### . . . WHERE SPACE IS LIMITED!

"In our particular installation small space plus big performance was our problem. We found the answer in the Skidmore Vertical "CV" Pump, it really does a big-size job." Capacities range—500 to 10,000 sq. ft. E.D.R. Discharge pressures—10 to 20 pounds. Write for informative bulletin No. 21.

### . . . WHERE ECONOMY COUNTS!

"I've always thought of Skidmore Pumps as first in *quality* and when the new Skidmore HS Model was introduced it filled the demand for *economy* with quality performance."

Type "HS" Pump will operate at a wide range of pressures. Write for bulletin No. 14-A., Dept. HV2.

*Manufacturers of Quality Pumps for Over a Quarter of a Century*

**SKIDMORE PUMPS**

**ST. JOSEPH, MICHIGAN**


**Baker Refrigeration Corp.**, South Windham, Me., has discontinued contracting operations in Omaha and St. Louis. **Central Ice Machine Co.** is now the Omaha distributor and a St. Louis distributor will be appointed. West coast contracting branches in Seattle, San Francisco, and Los Angeles will not be changed. The company has established four regions (northeastern, southern, central, and Pacific) each of which is in direct charge of a regional manager guiding the activities of the district managers in each region.

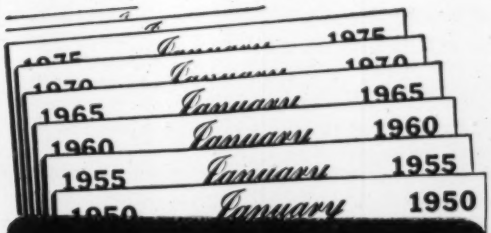
**Dravo Corp.**, Pittsburgh, has purchased the Marietta, Ohio, pipe fabricating plant formerly owned by International Derrick & Equipment Co. Operation of the new acquisition by the company's machinery division will follow the purchase and installation of equipment for the piping department. ..... **Buensod-Stacey, Inc.**, New York, engineering and contracting firm specializing in heating, air conditioning, and ventilating, has opened an office in the Dixie Bldg., Greensboro, N. C.

**J. R. Vernon**, sales promotion manager, **Johnson Service Co.**, Milwaukee, recently completed a speaking tour of southern and western states where he addressed groups of college engineering students and local chapters of the American Society of Heating and Ventilating Engineers and the American Society of Mechanical Engineers. To student groups, he presented a survey of the field of sales engineering as a career for technical men. Before engineering groups, he discussed the temperature control industry.

**Crane Co.**, Chicago, has opened a new branch at 1911 Salisbury Blvd., Salisbury, Md. Located in a new building which provides office, showroom, and warehouse facilities, the branch is in charge of **Raymond M. Carey**, formerly in the Baltimore office. ..... **Vapor Car Heating Co. of Canada, Ltd.**, Montreal, has purchased a second plant in Montreal which will be used to manufacture steam generators for Canadian railroads. The company is affiliated with **Vapor Heating Corp.**, Chicago.

The first completely coordinated training program for student heating engineers to be conducted since 1936 by **National Radiator Co.**, Johnstown, Pa., was recently completed. Diplomas were given to 20 recent engineering graduates who are now assigned to company branch sales offices. ..... **Henrik Manden**, Swedish heating engineer who is touring this country to study the heating and air conditioning industry, was a recent visitor at **L. J. Mueller Furnace Co.**, Milwaukee. He is traveling under the auspices of the Swedish Royal Board of Trade.

The recent general sales conference of **United States Radiator Co.**, Detroit, was attended by the entire field force of branch managers and salesmen. New products were introduced and the company's "three year plan" was presented by **Wesley J. Peoples**, chairman of the board and president. ..... **Semler Co.**, Jeannette, Pa., manufacturer of cast iron pipe fittings since 1915, has been purchased by **Kennedy Valve Mfg. Co.**, Elmira, N. Y. Officers of the new acquisition are **Charles F. Kennedy**, president. **J. Lawrence Kennedy** and **Howard P. Semler**, vice presidents; and **Thomas S. Turkington**, controller.




## FOR TROUBLE-FREE YEARS OF CORROSIVE WASTE DISPOSAL

**DURCO EXHAUST FANS**—Made in Durco corrosion-resistant alloys, Duriron, Durichlor or Durimet. Capacities from 20 to 5,000 c.f.m. Write for Bulletin 1103.

**DURIMET 20 SHEET**—For Fume Ducts and Hoods. A special Durco stainless steel with far greater corrosion resistance than ordinary stainless. Write for Bulletin 502.

**DURIRON BELL AND SPIGOT DRAIN PIPE**—Made of Duriron, a high-silicon iron alloy that withstands the attack of all commonly used acids except hydrofluoric and sulfurous acids and oleum. Standard sizes 1½", 2", 3", 4", 5", 6" and 8". Write for Bulletin 703.

Here are two important facts about the service-life expectancy of corrosive-waste systems

1. An investigation of a large number of chemical laboratory waste systems showed that ordinary materials last an average of *less than two years* in this service.

2. Durco equipment has *permanent* corrosion-resistance as thick as the metal itself. As a result of this alloyed-in self-defense, *Durco equipment installed more than twenty years ago is still in service, today.*

Remember these two points when you specify the exit route for corrosive liquids or fumes.

DURCO Adv. 109-GM

DURCO

THE DURIRON CO., INC.
DAYTON 1, OHIO
*Branch Offices In Principal Cities*

## . . . the new GREENLEE PIPE BIT SET

Designed especially for plumbers, steamfitters and electricians to provide fast, easy boring of accurate holes in wood for ½" to 2" pipe and conduit. Makes swift, easy work of an otherwise tedious, hard job! The set is furnished in a sturdy, attractive metal box with convenient carrying handle. Bits have ½" shanks for use in portable electric or pneumatic drills and in stationary boring machines. An adapter is provided for standard auger-bit braces. Adapters are also furnished for using standard ⅜" pipe as an extension for deeper boring and longer reach. Get facts today on these timesaving GREENLEE tools. Write Greenlee Tool Co., Division of Greenlee Bros. & Co., 2345 Twelfth Street, Rockford, Illinois.

TOOLS FOR CRAFTSMEN
GREENLEE

# THERMOBLOC

## THE MOST *Adaptable*

## SELF-CONTAINED • DIRECT-FIRED

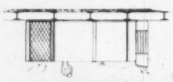
## *HEATER ON THE MARKET!*

All the essentials of a heat producing system are contained in THERMOBLOC'S smartly styled casing when it is shipped from the factory. THERMOBLOC requires no assembly, occupies the smallest floor area per btu, and its "straight-through" design provides flexibility of applications not possible with other types of heating devices.

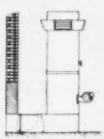
A few of the variety of uses to which THERMOBLOC has been put are shown here. Variations of one of these might just answer *your problem.*

THERMOBLOCS are offered in two standard sizes: Model 300, 30 inches in diameter and 7 feet high, delivers 300,000 btu's at 3000 C.F.M. Model 550, 30 inches in diameter and 10 feet high, delivers 550,000 btu's at 4800 C.F.M. Prat-Daniel Corporation, designers and manufacturers of THERMOBLOC, offer a new bulletin giving complete engineering data to aid you in estimating your heating requirements. Write for your copy today!

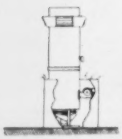
**FILTERED AIR**—For use where large quantities of dust are present, such as woodworking shops



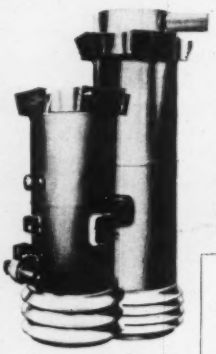
**SUSPENDED HEAT**—Where necessary, THERMOBLOC can be hung on roof trusses

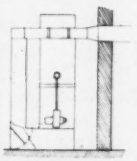


**TEMPERING MAKE-UP AIR**—Adjustable for 100% make-up air or 100% recirculation

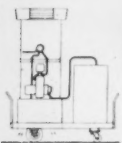


**GARAGES and TERMINALS**—Where inlet requirements are a minimum height from floor



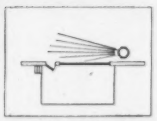


**HIGH TEMPERATURE**—With recirculation duct for drying processes



**PORTABLE HEATING**—Mounted on steel truck

**MODEL 300 MODEL 550 THERMOBLOC UNIT HEATERS**



**DOOR CURTAIN**—To warm air entering through large open door

**THERMOBLOC DIVISION**

**PRAT-DANIEL CORPORATION**

*Manufacturers of Prat-Daniel Power Equipment*

**70-5 WATER ST.** — **E. PORT CHESTER, CONN.**


**C. A. Dunham Co., Ltd.**, London, England, is planning a factory addition which will double its present floor space. The firm is an affiliate of **C. A. Dunham Co.**, Chicago. ..... As a part of its 130th anniversary celebration, **Builders Iron Foundry** and its affiliated industries, **Builders-Providence, %Proportioneers%**, and **Omega Machine Co.**, recently held a dedication and open house at its new quarters located at 345 Harris Ave., Providence, R. I. Some 1500 persons visited the new office building and toured the various manufacturing departments.

New passenger cars, 152 in all, being built for the Chesapeake and Ohio Railway Co. by Pullman-Standard Car & Mfg. Co., are being equipped with "Dorex" activated carbon "air recovery" panels manufactured by **W. B. Connor Engineering Corp.**, New York. Four panels are being used in the air conditioning system plenum chamber of each car. ..... **General Controls Co.**, Glendale, Calif., has started construction on a $100,000 plant addition. The new facilities will be used for assembly operations of automatic pressure, temperature, level, and flow controls.

**Iron Fireman Mfg. Co.**, Cleveland, has inaugurated an expanded sales program by sponsoring a two-week training school for its entire field organization. During the year, additional small schools will be held for dealers throughout the country. More than 100 field sales representatives, division engineers, branch managers, and engineers recently spent two weeks at the main plant. Last month at the National Oil-Heat Exposition, the company offered a preview of a new rotary cup oil burner of the commercial-industrial type.

A transparent and life-size plastic man, used to demonstrate bodily reactions to temperature changes, is a feature of a touring display designed to illustrate the sensitivity of automatic control in creating "indoor climate". The model has two lighting systems, one blue and one red, to represent the body's network of nerves and arteries. It was recently unveiled by **Minneapolis-Honeywell Regulator Co.**, Minneapolis.

**Modern Heat, Inc.**, is now a distributor in the Philadelphia area for the rotary oil burners of **Enterprise Engine & Foundry Co.**, San Francisco. ..... **John Wood Mfg. Co.**, Conshohocken, Pa., has simplified its name to **John Wood Co.** ..... **Union Asbestos & Rubber Co.**, Chicago, has opened a new plant for the production of pipe covering in McGregor, Tex.

A new series of educational shows, put on by **Penn Electric Switch Co.**, Goshen, Ind., for refrigeration engineers and service men, got under way in Detroit last month. Created to give a visual demonstration in the use, construction, installation, and servicing of automatic controls, the show will be held throughout the northeastern and Atlantic seaboard states. ..... At a meeting attended by some 40 representatives, **D. C. Goff**, manager, **Z-Crete Div., Zonolite Co.**, Chicago, described the development and application of the firm's system for insulating underground heated piping.

## BUILD BUSINESS WITH

FRICK

## UNIT AIR CONDITIONERS

People like the refreshing coolness and freedom from humidity these Units bring to your restaurant, office or shop.

Frick Air Conditioners have the features you want: large cooling capacity, quiet operation, excellent economy, sealed refrigerating unit, variable-speed fan, self-cleaning filter, adjustable air outlets, and beautiful glazed blue-grey finish.

Frick Unit Conditioners installed in the 'Thirties are still good for years of service. Get full details: ask for Bulletin 522.

The Hill Cafe in Harrisburg, Penna., Has Used Three Frick Unit Air Conditioners Eleven Years.

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA. U.S.A.

*Also Builders of Power Farming and Sawmill Machinery*

## ELCO CUT THREADING PUTS QUALITY IN "THE SCREWS YOU LIKE TO USE"

Cut threading is the oldest — and, for certain purposes, still the best way to make screws. At ELCO, hundreds of cut threaders . . . each a small, specially-tooled automatic lathe . . . work through the day and much of the night. Each screw blank is threaded by a series of successively deeper cuts. Results — sharp and uniform points, smooth thread surfaces, sharp edges that cut cleanly for easier driving, easy set-up for special forms, and accurate control of significant dimensions. Our extra attention to quality assures you of receiving good screws — ELCO Screws.

**CLOSE-UP TO THE POINT**

Carving out a 2¼–14 wood screw on an ELCO cut threader. This shows the fifth of seven cuts. Note the *smooth* thread, *clean* edge, and *sharp* point.

ELCO TOOL & SCREW CORPORATION

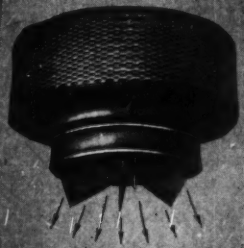
1920 BROADWAY · ROCKFORD, ILLINOIS

McCORD
HEATING AND
AIR CONDITIONING
PRODUCTS

BLAST HEATING COILS—AIR CONDITIONING COILS—ALL TYPES

All copper spiral fin tube construction with the tubes formed or bent permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and metallically bonded. May we send catalog?

VERTICAL TYPE UNIT HEATERS



A proven heating unit, modern in design, incorporating every unit heater advancement. McCord copper spiral fin tube construction creates air turbulence without undue restriction. Improved fan blades deliver large volume of air with minimum air noise. Guaranteed for 150 lbs. saturated steam pressure. Specify McCord.

HORIZONTAL TYPE UNIT HEATERS

A time proven heating unit, modern streamlined in design, quiet, yet its rugged construction adapts it to all types of installations, guaranteed for use on No. 150 p. s. i. steam pressure. All copper heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Wide range of capacities.

Save fuel with McCord Unit Heaters.

McCord CORPORATION
DETROIT 11, MICH.


# WHO'S WHAT

**A. G. Zumbrun,** executive vice president and chairman of the board of **Brunner Mfg. Co.,** Utica, N. Y., has been elected president. He succeeds **G. L. Brunner, Jr.,** who has resigned to devote all his attention to the management of Brunner Corp. (Canada) Ltd. ..... **James C. Matchett** is now president and treasurer of **Illinois Engineering Co.,** Chicago. **Gordon L. Harris** is vice president and assistant treasurer and **L. B. Carlson** is secretary. **Robert L. Gifford,** who has served as president and treasurer since the incorporation of the firm in 1900, is chairman of the board.

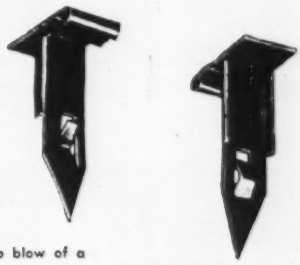
**Robert H. Morse, Jr.,** who started with the company in 1916 and who is the third generation Morse, is now president of **Fairbanks, Morse & Co.,** Chicago. Previously vice president in charge of operations, he has succeeded his father, **Colonel Robert H. Morse,** now chairman of the board. **O. O. Lewis** is the new vice president in charge of sales and **F. J. Heaslip** has been elected vice president in charge of purchases and traffic. Both of these men have been associated with the company for many years.

**P. B. Postlethwaite,** president of **Wagner Electric Corp.,** St. Louis, and chairman of the executive committee for the past 24 years, has retired as president, at his own request, and has been elected to the newly created office of chairman of the board. He will continue as chairman of the executive committee. **J. H. Devor,** who has been vice president since 1941, is the new president. **A. H. Timmerman** has retired as vice president and director and is succeeded, as a director, by **G. A. Waters,** vice president in charge of manufacturing. **H. N. Felton,** manager of the St. Louis sales branch, is now vice president in charge of sales, and **L. W. McBride,** credit manager, is assistant secretary-treasurer, succeeding **A. K. Bahret** who has reached retirement age after 50 years with the company.

**Stoddard M. Stevens,** partner in the law firm of Sullivan and Cromwell, New York, and **J. H. King,** vice president of Babcock & Wilcox Co., have been elected to the board of directors of **Babcock & Wilcox Tube Co.,** Beaver Falls, Pa. **C. B. Marshall, Jr.,** has been transferred to the sales force of the Chicago district office. He had been managing the Alliance, Ohio, general sales office of the company's welded tube division. ..... The Dallas branch of **Kaylo Div., Owens-Illinois Glass Co.,** Toledo, has been transferred to Houston and **J. K. Dickson** has been named sales engineer for the Houston territory. Another new branch, in Oklahoma City, will be added soon.

**W. H. Evans,** who joined the company in 1931 as accountant and office manager, has been named vice president and director of **Minneapolis-Honeywell Regulator Co., Ltd.,** Leaside, Ontario. He will continue in his present position of general manager. ..... The management of **Cyclotherm Corp.,** Oswego, N. Y. has been reorganized and additional working capital has been made available. **Lewis H. Dietz,** who has been associated with

*Simplify* **fastening insulation to metal ductwork with LEXSUCO INSULATION CLIPS**



**SIMPLE** — Just insert the clip in the insulation and with the sharp blow of a hammer, it locks itself to the metal duct. The shoulder prevents penetration beyond insulation thickness.

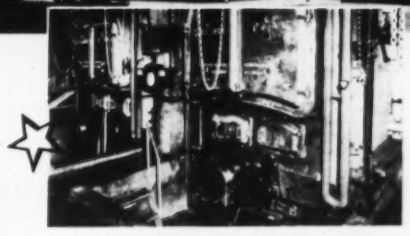
**SPEEDY** — This easy "hammer and nail" method provides very fast application.

**LABOR-SAVING** — No preparation of the surface; no special tools or completing materials needed.

**SIZES** — Available for 1/2", 13/16" and 1" thick insulation.

**The LEXINGTON SUPPLY CO.**
4815 LEXINGTON AVE CLEVELAND 3 OHIO

DEPT. 106



. . . in Minneapolis
**3 ENTERPRISE BURNERS**
provide dependable heating for the modern Star-Tribune Building

In 1948, after six year's experience with Enterprise Oil Burners, the Star-Tribune installed two more burners to boost their heating, air-conditioning and hot water capacity. The choice again was Enterprise—based on high satisfaction with this quality equipment—its remarkable dependability and economy.

When you specify Enterprise you can be sure of the finest in oil burning equipment.

**Enterprise Full Automatic Oil Burners, like the K2G's installed in the Star-Tribune building, are widely used to secure the lowest cost heating performance without need of more than occasional inspection.**

***Sold by Grudem Brothers Co., distributor, Minneapolis, Minn.***

**ENTERPRISE**
*Oil Burners*
*The Choice of Heating Experts*

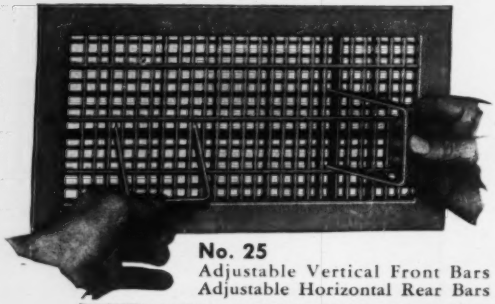
**BURNER DIVISION OF ENTERPRISE ENGINE & FOUNDRY COMPANY**
**18th & FLORIDA STS., SAN FRANCISCO 10, CALIFORNIA**
***DISTRIBUTORS IN PRINCIPAL CITIES***

INDEPENDENT

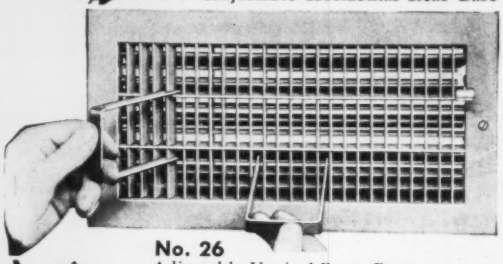
"Fabrikated"

DOUBLE CORE ADJUSTABLE BAR WALL GRILLES AND MULTIPLE VALVE REGISTERS

Each Grille Bar Adjusted Individually



No. 25
Adjustable Vertical Front Bars
Adjustable Horizontal Rear Bars



No. 26
Adjustable Vertical Front Bars
Adjustable Horizontal Rear Bars—with Horizontal Multiple Valves.

Depth with valves closed 1⅜"
Depth with valves open 2¼"

write for new catalog no. 50

MEMBER NATIONAL WARM AIR HEATING AND AIR CONDITIONING ASSOCIATION INDOOR COMFORT

Always Leading • Always Progressing

THE INDEPENDENT REGISTER CO.

3747 E. 93rd STREET • CLEVELAND, OHIO


the firm as west coast distributor and who owns and operates Pacific Engineering and Equipment Co., of Portland, Ore., is now vice president in charge of sales. **A. P. Saha,** newly elected vice president in charge of production and engineering, has been actively identified with the company since its organization.

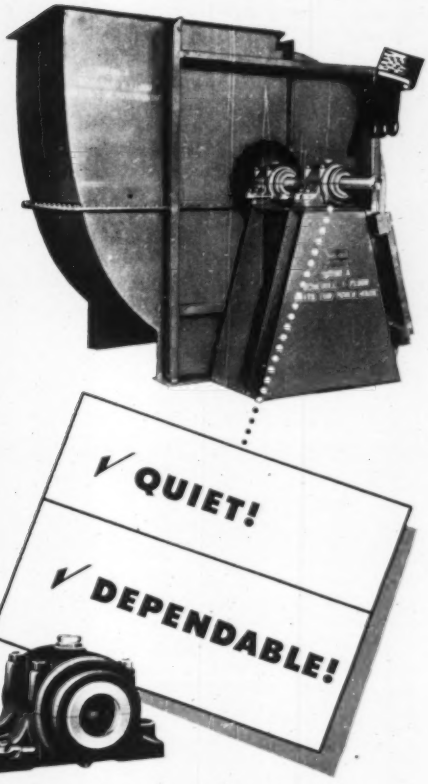
**R. H. Israel,** sales manager, refrigeration dept., Virginia Smelting Co., has been elected president of the **Refrigeration Equipment Manufacturers Association.** He succeeds **K. B. Thorndike,** vice president of Detroit Lubricator Co. Other officers serving with Mr. Israel are: vice president—**W. A. Siegfried,** president, Superior Valve & Fitting Co.; treasurer—**W. J. Stelpflug,** vice president, Hussmann Refrigeration, Inc.; secretary—**John E. Dube,** president, Alco Valve Co. The new officers, with Mr. Thorndike, constitute the executive committee of REMA for the fiscal year.

The late **Myles J. Stanton,** of the air conditioning dept., **General Electric Co.,** Bloomfield, N. J., is listed among the 47 winners of the Charles A. Coffin Award for work of outstanding merit during 1949, the company's highest honor to employees. The citation was made for the development of a method for bonding aluminum fins to copper tubing which results in an improved design and lower production costs. ..... **Carlton S. Proctor,** New York consulting engineer, is chairman of the **Construction Industry Advisory Council**—an organization composed of more than 100 national trade and professional groups. A member of the firm of Moran, Proctor, Freeman & Mueser, he has succeeded **James R. Edmunds, Jr.,** of Baltimore.

At a recent meeting of the board of directors of **Link-Belt Co.,** Chicago, **David E. Davidson** was elected vice president for sales and all officers who served last year were re-elected. He has been general manager of the Pershing Road plant, Chicago, and is succeeded by **Eugene P. Berg,** assistant general manager of the plant. ..... **Cecil H. Gay,** works manager of the Barberton plant of **Babcock & Wilcox Co.,** New York, was recently elected vice president. He joined the company in 1928 and has been connected with the Barberton operations since 1932.

**Perfex Corp.,** Milwaukee, has elected **Arthur J. Brennan,** works manager, to the position of vice president. Before joining the firm in 1947, he was manager of purchasing and production at the Rochester products division of General Motors Corp. ..... Succeeding **L. C. Freeman** who has retired, **C. M. Baker** is now chief engineer of the Kalamazoo, Mich., works of **Ingersoll Steel Div., Borg-Warner Corp.,** Chicago. He joined the company in 1944 and had been assistant chief engineer. ..... **Richard A. Biggs** is the new director of architectural development for **Crucible Steel Co. of America,** New York. He was formerly development engineer of Pittsburgh Corning Corp.

As manager of the market extension division, general sales, **Brown Instruments Div., Minneapolis-Honeywell Regulator Co.,** Philadelphia, **Douglas M. Considine** is



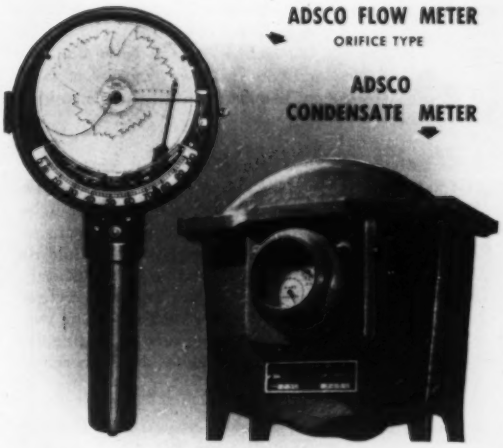

## DODGE SLEEVOIL BEARINGS — PLAIN OR WATER-COOLED

Dodge Sleevoil Bearings are engineered to the *exacting* requirements of fan and blower manufacturers. They combine quietness, load-carrying capacity and dependability to a degree unique in the bearing field. They are available from stock in both plain and water-cooled types, in shaft sizes from 1-7/16" to 8".

Dodge offers you America's most complete line of bearings for fan and blower service, both sleeve and anti-friction types. Carried in distributors' stocks. Look for the name of the Dodge Transmissioneer nearest you (your local Dodge Distributor) under "Power Transmission Equipment" in your classified telephone book. Or write direct to us for complete details.

**DODGE MANUFACTURING CORPORATION**
**1600 UNION STREET, MISHAWAKA, INDIANA**

**DODGE**
*of Mishawaka, Ind.*




# ADSCO METERS

## for accuracy and trouble-free service

ADSCO FLOW METER Today's rising fuel and operating costs make it imperative to know—and to know accurately — how much steam, water and gas is being used. The ADSCO Flow Meter provides a permanent, evenly divided chart, illuminated rate of flow indicator and a direct reading totalizer — the necessary records to establish costs and usage per day, week or month.

Rugged, simple construction . . . magnetic transmission *without* stuffing box . . . no friction loss to affect accuracy . . . less maintenance. Cannot be damaged by sudden overload or reverse flow. Suitable for working pressures to 300 psi or to 1000 psi when equipped with high pressure body. 16 models. *Send for Bulletin No. H-35-83A.*

ADSCO CONDENSATE METER for accurate, economical metering wherever all condensate can be recovered. Widely used by district heating companies, industrial plants, colleges and hospitals to provide a record of steam cost per building or department. Can be used to meter the steam consumption of heat exchangers, blast coils, unit heaters and process equipment.

Low in cost, easily installed and maintained. Operates under vacuum or gravity conditions. In 7 sizes from 250 to 12,000 lbs. per hour. Accurate within 1% at all rates of flow to 150% of rated capacity. *Write for Bulletin No. H-35-80B.*

EXPANSION JOINTS — HEAT EXCHANGERS
STEAM TRAPS — STRAINERS — METERS
CASING — ANCHORS — GUIDES

*Leaders Since 1877*

**AMERICAN DISTRICT STEAM CO**
NORTH TONAWANDA, N. Y.

directing advertising and technical and trade editorial activities. He continues as technical editor of the company's house-trade publication. ..... **John A. Menster,** who joined **Babcock & Wilcox Tube Co.,** Alliance, Ohio, in 1943 and who has been engaged in sales development, is assistant manager of sales for the welded tube division.

**O. V. Tally** has become midwest regional manager for **Allis-Chalmers Mfg. Co.,** Milwaukee, succeeding **Benjamin F. Bilsland,** who will retire the first of July, after more than 30 years of service. Mr. Tally was formerly manager of the St. Louis district where he is succeeded by **Baldwin G. Witty,** formerly a sales representative in the Chicago office. **R. D. Moody,** manager of the San Francisco district, is now in charge of the Los Angeles district, taking over the post of **C. W. Schweers,** who is now managing the New England region. **James A. Longley, Jr.,** is in charge of the San Francisco office.

Elevation of three men to newly created sales positions was made recently by **Iron Fireman Mfg. Co.,** Cleveland. **Howard M. Cutshaw,** assistant sales manager, is now domestic division sales manager. **Stewart H. Kibbe,** Minneapolis division engineer, has been named industrial division sales manager, and **C. D. Carter,** central division sales manager, is the new assistant sales manager in charge of organization development. These promotions are said to be a part of the company's expanded sales program and the separation of industrial and domestic sales. Mr. Carter is in charge of new dealer selection and the field sales training program.

**Richmond Radiator Co.,** New York, an affiliate of Reynolds Metals Co., has named **James E. Sargeant** sales manager for the heating division. He joined the company three years ago and prior to that distributed and sold building and heating material in the southeastern portion of the country. ..... **Fred R. Paris,** for 10 years with Worthington Pump and Machinery Corp., is a district representative for **Marlow Pumps,** Ridgewood, N. J. He is in charge of industrial pump sales in New York state and part of Canada.

**John B. Moxness** is the new industry engineer in charge of sales promotion of control devices for **Brown Instruments Div., Minneapolis-Honeywell Regulator Co.,** Philadelphia. ..... **Herbert A. C. Smith** has been added to the staff of **Alco Valve Co.,** St. Louis, as field engineer. With headquarters in Philadelphia, he will cover eastern Pennsylvania, southern New Jersey, and the states of Delaware, Maryland and Virginia, together with the District of Columbia. Since 1947 he has been district manager in the St. Louis area for Baker Refrigeration Corp.

Formerly with Northern Equipment Co., **David T. Morgenthaler** is managing sales of **Delavan Mfg. Co.,** Des Moines, Iowa. ..... As the new assistant sales manager of the welding division, **Harnischfeger Corp.,** Milwaukee, **A. G. Hendrickson** is aiding **Melvin O. Monsler** who was recently promoted from assistant to sales manager. Mr. Hendrickson has had many years of experience with the company. ..... Succeeding the late **P. F. McGuinn,** who for many years was vice


GET MORE AIR CONDITIONING BUSINESS WITH

# TYPHOON

*America's Most Flexible Line of Air Conditioners*

**1½ TO 20 TONS**

- Wide range of sizes — 1½ to 20 tons — makes it easy to sell the right air conditioner for the right job. Typhoon engineering is a byword in the industry — pioneers of many major advances in modern air conditioning.
- Over 40 years of experience in research and manufacture in the air cooling field.

**1½-2-3 Ton Units** for office suites, homes, small retail stores and service shops...efficient, low cost performance in small space installations.

**5-7½ Ton Units**—Most widely used of all Typhoon free-standing air conditioning units. Ideal for the average retail store, small and medium-sized theaters, and food markets.

**8-10 Ton Units**—Large capacity unit in a small, compact package to answer all the air conditioning requirements of the average theater, large store and office installations.

**15-20 Ton Units**—Newest Typhoon achievement...packaged air conditioning for large theaters, arenas, supermarkets and other buildings requiring high cooling output. Specifically engineered to eliminate the need for costly and bulky central plant systems.

**EVAPORATIVE CONDENSERS: 3 to 20 Tons**—Save 95% of water—and water costs.

**TYPHOON AIR CONDITIONING CO., Inc.** 794 UNION STREET, BROOKLYN, N. Y.

# IRON BULWARK

AGAINST CORROSIVE FLUIDS

## Fairbanks®
### all iron gate valves

...are made of high-test alloy iron to withstand the action of many of the strongest chemicals such as concentrated sulfuric acid, alkalies, aniline oils, sodium and potassium cyanides and creosote. These iron body valves give long service under the severe operating conditions that exist with use of these destructive agents.

Fairbanks All Iron Gate Valves—like those in all Fairbanks lines—are low in maintenance cost, easy to operate and long-lasting in service ...a real answer to cost-cutting needs today.

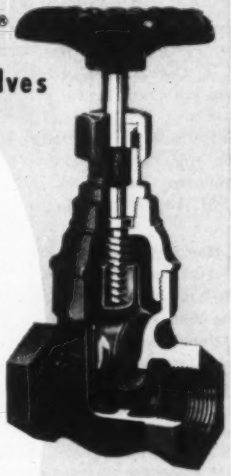


Fig. 0318
ALL IRON GATE VALVE
150# SWP 225# WOG
Non-Rising Stem • Solid Wedge • Taper Seat
½"-2" Sizes

Fig. 0904
ALL IRON GATE VALVE
125# SWP 200# WOG
Solid Wedge • Taper Seat • Malleable Iron Seat Rings
2"-12" Sizes

Fig. 0418
IRON BODY U-BOLT GATE VALVE
150# SWP 225# WOG
Bronze Mounted • All Iron Rising Stem • Solid Wedge • Taper Seat
½"-4" Sizes

For handling other types of corrosive fluids such as dry carbon dioxide, ethyl acetate, malt beverages, propane and butane gas use Fairbanks Bronze Solder End and Fairco-Braze (silver-brazed) Valves.

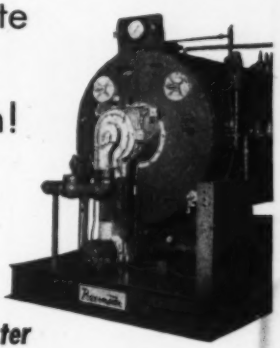
For full details consult your distributor or write direct

THE Fairbanks COMPANY
393 LAFAYETTE STREET • NEW YORK 3, N. Y.
Branches: New York 3 • Pittsburgh 22 • Boston 10 • Rome, Ga.

CASTERS • TRUCKS • VALVES • DART & PIC UNIONS



# CUTS COSTS
because it is easy to operate and maintain!



***O & S Powermaster gives you cost-saving features like these...***

1. **FUEL SAVINGS UP TO 30%.** Designed to operate efficiently with inexpensive heavy oils as well as light oils or gas. (Change oil to gas or gas to oil *in 10 minutes!*)
2. **LOW-COST MAINTENANCE.** Swinging rear and removable front covers make cleaning easy—without dismantling burner or controls. Also saves inspection time.
3. **AUTOMATIC OPERATION.** Ignited electrically with gas or light oil. Produces full steam pressure quickly. Operates only as steam is needed.
4. **PACKAGED DESIGN** saves installation costs. Delivered fully wired, factory-tested and mounted on steel base. No bricking required.

High and low-pressure units—15 to 300 H.P.—for light oil, heavy oil, gas or combination gas-oil firing. Free catalog mailed promptly—use coupon below.

**ORR & SEMBOWER, INC.**
Established 1885

Powermaster® STEAM GENERATORS

ORR & SEMBOWER, INC.
990 Morgantown Rd., Reading, Pa.

Please mail latest catalog showing Powermaster's cost-cutting advantages.

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Company_____
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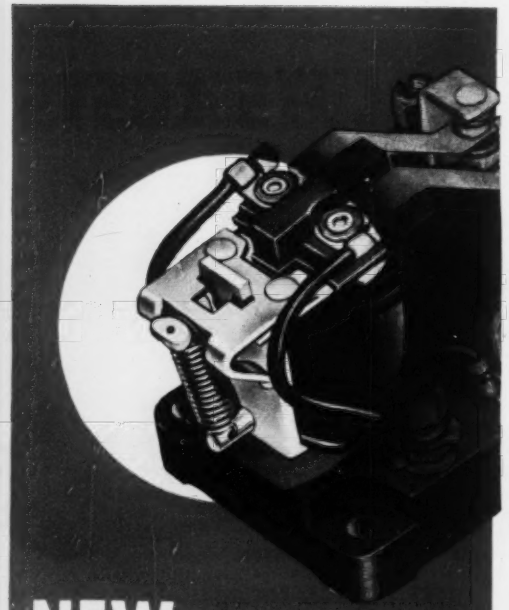


NEW—

a Mighty Midget Built for Millions of Operations

semi-knife-edge bearing reduces frictional wear

This is Ward Leonard's new Bulletin 110 Midget Relay for long, trouble-free service, particularly in equipments subject to vibration.

Exceptionally good vibration characteristics are due to proper proportioning of contact masses and springing combined with heavy pressures on both normally open and normally closed contacts.

Higher contact ratings than most midgets. Available up to 3-pole, double throw. Contact finger leads are insulated with the new, impregnated glass-fiber tubing.

Write for Bulletin 110. Ward Leonard Electric Co., 24 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

WARD LEONARD ELECTRIC COMPANY

Result-Engineered Controls

RESISTORS • RHEOSTATS • RELAYS • CONTROL DEVICES

president and purchasing agent, **H. F. Hagenauer** is now purchasing agent for **Ahlberg Bearing Co.**, Chicago. Mr. Hagenauer has been with the firm 31 years and became assistant purchasing agent in 1922.

**Tinnerman Products, Inc.**, Cleveland, has opened a district office at 7614 Wydown Blvd., St. Louis. **Carl F. Marcussen**, of the Chicago district office, is in charge. ..... With headquarters in Des Moines, Iowa, and covering the entire state (except for the southwestern corner) as well as the northwestern counties of Illinois, **S. T. Carlson** is a factory representative for the heating and air conditioning products of **McQuay, Inc.**, Minneapolis. ..... The firm of **Augur, Jones & Green**, 62 La Salle Rd., Hartford, has been named representative for the state of Connecticut by **Anemostat Corp. of America**, New York. The organization is headed by **J. M. Augur, R. C. Jones, and A. F. Green.**

**Harry A. Abrams** has been made Washington, D. C., district manager of **John Wood Co.**, Conshohocken, Pa. He has been with the company since 1917 and has served the Washington-Baltimore area since 1927. **M. F. Piersol**, of the Philadelphia territory, has been promoted to district manager of that office. ..... Representation of the **Janitrol Div., Surface Combustion Corp.**, Toledo, is now being handled in the Cincinnati district by **Robert A. Henley.** In charge of dealer operations, he succeeds **Charles C. Owen**, who has been advanced to sales promotion manager.

**Raymond S. Doherty** has joined the general sales department of **National Radiator Co.**, Johnstown, Pa., and is assigned to sales development of steel boilers. Since 1928 he has been affiliated in sales management positions with several manufacturers of heating equipment. **Roland A. Hazell**, who has been covering central New York state for the last two years, is now in charge of the new Buffalo office. **Phillip A. Formel** has been assigned to the Philadelphia office and has taken over the central New York territory. **Paul J. Bracken**, manager of the Boston office for the last 16 years, is now in charge of the Philadelphia branch. He is succeeded by **Henry F. White**, sales representative in the eastern Massachusetts territory since 1936. **Orville H. Mowbray** has rejoined the sales engineering staff and has been again assigned to the Baltimore branch sales office. With headquarters in the Colcord Bldg., Oklahoma City, **L. W. Ellis** is handling sales representation for the company in Oklahoma and the western part of Arkansas.

**F. F. Tiffany**, former district manager of the Dayton, Ohio, office of the general sales division, **Reynolds Metals Co.**, Louisville, has taken over the duties of division manager in the Pittsburgh area. **T. D. Lewis**, formerly sales representative in the San Francisco area, is now division manager located in the Atlanta office. Four new distributors handling the company's general line of mill products are: **Mutual Mfg. & Supply Co.**, Cincinnati; **American Steel & Alloys Corp.**, Hartford, Conn.; **Merchant & Evans Co.**, Philadelphia; **Athos Steel Service Co.**, Philadelphia. Three new distributors for pig and ingot products are: **Silverstein & Pinsoff, Inc.**, Chicago; **Rochester Smelting & Refining Co.**, Rochester, N. Y.; **Atlas Metal Co.**, Cleveland.

# Jaden Newly Designed AIR CONDITIONERS

## Water Refrigerated

Floor Model

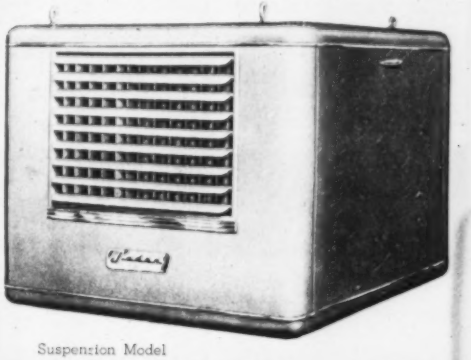
**Is yours a "cold water" area?** If so, just think of the advantages you'll have with the Jaden line of "Water-Cooled" air conditioners! **SIMPLER IN DESIGN . . . LOWER IN PRICE . . . LESS COST TO OPERATE!** There's nothing can compare with the Jaden for cooling economy. You'll underbid every competitor.

**CHOICE OF MODELS AND SIZES.** Suspension and floor units. For private offices, living room, hospital room, barber shop, beauty parlor—up to cafes, stores, banks, shops, etc.

**ALL-YEAR USE.** Cold water COOLS in summer. Hot water HEATS in winter.

**DEALERS**

If you are located in a cold water area (60° or less) write now for catalog and full information.



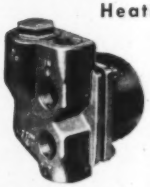
Suspension Model

**JADEN MFG. COMPANY ..... Hastings, Nebr.**



# Sterlco Heating and Temperature Control Products

### Heating Specialties



¾" 69-B Float and Thermostatic Trap.

**Thermostatic Traps:** ½" to 1" sizes; low, medium, high pressure; wide variety of body styles.

**Float and Thermostatic Traps:** ¾" to 2" sizes; low and high pressure.

**Strainers:** ⅜" to 2" sizes; cast iron or brass bodies. Also *Radiator Valves, Vents, Boiler Return Traps.*

### Temperature Control Valves

120-A Thermotrol Individual Radiator Temperature Control.

**No. 120 Thermotrol:** Self-contained individual radiator temperature control for steam or hot water. Easily installed in place of manual radiator valve. Sizes ½" to 1"; all body styles.

**Tank Temperature Controls:** Self-powered modulating control valves for fluid heaters and all types of process equipment for heating or cooling. Sizes ⅜" to 2".

### Condensation and Vacuum Pumps

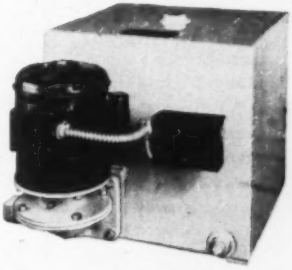
**4100 Series:** Compact, economical condensation pumps with 15 or 30 gallon steel tank, dual voltage capacitor type motor, rotary seal, and simple, sturdy vertical centrifugal pump. For all low pressure jobs up to 14,000 sq. ft. E.D.R. and 20 lbs. pressure.

**4200 Series:** Same as 4100 Series except cast iron tanks.

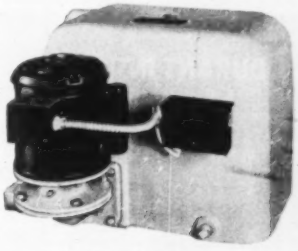
**3500 Series:** Heavy duty condensation pumps with pedestal mounted steel tank, for a wide range of jobs — 2000 to 65,000 sq. ft., up to 150 lbs. pressure.

**3700 Series:** Condensation pumps with heavy cast iron tank for installation underground or in wet locations. 2,000 to 20,000 sq. ft., 20 or 30 lbs. pressure.

**Vacuum Pumps:** Type V, 2500 and 5000 sq. ft., 20 lbs. pressure. Type S, 10,000 to 40,000 sq. ft., 20 to 40 lbs. pressure.



4126-B Condensation Pump (Steel Tank)



4226-B Condensation Pump (Cast Iron Tank)

*Descriptive bulletins with complete specifications of any of the above products will be furnished promptly upon request.*

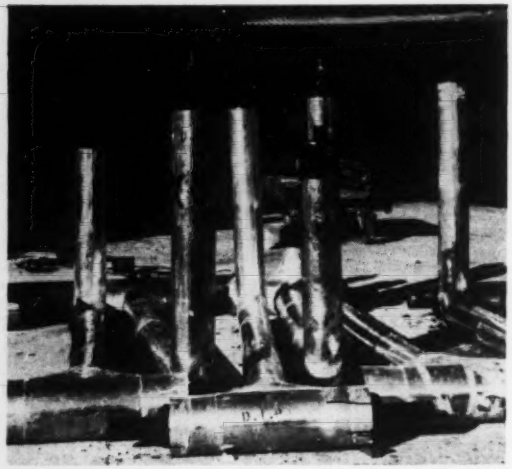
***Distributed through Leading Heating and Plumbing Wholesalers***

***Sales Representatives in Principal Cities***

**STERLING, INC.** 3732 N. Holton Street Milwaukee 12, Wisconsin

D.I.P. ENGINEERED for Positive Protection

REG. U. S. PAT. OFF.



## Combine Minimum Field Costs with Long Term Dependability

• DURANT Pre-Sealed INSULATED PIPE is the ORIGINAL positive protection to maintain low heat loss in the conveyance of steam, hot water, or refrigerants in underground or exposed piping. It is completely waterproof and eliminates corrosion and electrolysis.

Many leading architects and engineers specify D. I. P. wherever long term dependable service is required. Both installation and maintenance costs are kept at a minimum. No tile or masonry protection is required and field joint work is a simple four step process.

Our representatives, conveniently located in principal cities, are at your service. Or we will be glad to provide catalog and engineering data on request.

PRE SEALED

REG. U. S. PAT. OFF.

DURANT INSULATED PIPE COMPANY

1015 Runnymede St. East Palo Alto, California

**Marsh Heating Equipment Co.**, sales affiliate of **Jas. P. Marsh Corp.**, Skokie, Ill., has appointed **Kress Engineering and Sales Co.**, Grand Rapids, Mich., representative for the western half of Michigan. **Marcus-McCauley and Associates**, 239 Fourth Ave., Pittsburgh, is handling representation in that area. ..... **Randall S. Stover**, Room 502, 1424 K St., Washington, D. C., is the new factory representative in the Washington area for **McQuay, Inc.**, Minneapolis. ..... **Mullins Engineering Co.**, Little Rock, Arkansas, is now the sole distributor in that state for **Bryant Heater Div., Affiliated Gas Equipment, Inc.**, Cleveland. **J. E. Mullins**, who formed his own company in 1946, was formerly with Central Supply Co.

**Lincoln Electric Co.**, Cleveland, has increased the staffs of several offices. **J. W. Brooks** is now serving the Boston area as a welding engineer. **J. J. Chemerys**, formerly with Joy Mfg. Co., is handling industrial accounts in the Syracuse territory, and **W. R. Karll** is in the Newark, N. J., office. **R. G. Todd** has been added to the staff of the Tulsa office. ..... **Industrial Sound Control, Inc.**, Hartford, Conn., has appointed **Ralph Pat Kelley & Associates**, 1521 Southwest 11th Terrace, Miami, representative in the state of Florida. The firm has represented a number of manufacturers in related lines for many years.

The air conditioning contracting firm, **Air-Gineers**, P.O. Box, 121 Brunswick, Ga., has been formed by **Mitchelle E. Colley** who has resigned his position as engineer-administrative assistant to the Glynn County Board of Education. The new firm will have jobbing, engineering, and contracting divisions. ..... **Harold Sweeney**, formerly with Southern Refrigeration Co., has been appointed to Baltimore branch refrigeration sales of **Hajoca Corp.**, Philadelphia. He replaces **Paul Stewart** who is in charge of refrigeration sales at the Jacksonville branch. **LeRoy E. Fritz**, who was in business for himself for a number of years, has been added to the Reading, Pa., branch.

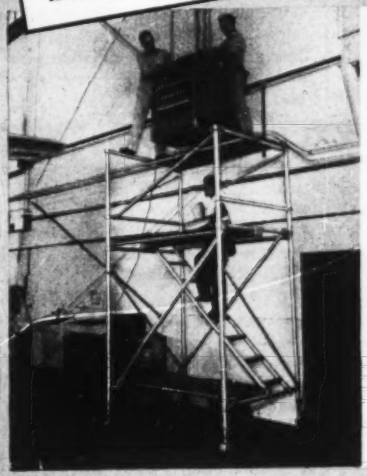
**Payne-Ladewig, Inc.**, is the new wholesale distributor in the Dallas, Tex., region for **Payne Furnace Div., Affiliated Gas Equipment, Inc.**, Monrovia, Calif. Heading the new concern is **Larry L. Ladewig**, formerly with the Houston Natural Gas Corp. ..... New representatives for **Gil-Lair Products, Inc.**, Pasadena, Calif., are: **Tom S. Andrews**, Oklahoma City; **Application Co.**, New York City; **W. Philip Cox**, Washington, D. C.; **H. A. Ferguson**, Baton Rouge, La.; **Edwards and Son**, Pittsburgh; **Walter J. Ottinger**, Toledo; **Keystone Tool Corp.**, Houston, **Paul B. Mueller Co.**, Minneapolis. **Allied Supply Co.**, Los Angeles and **Mission Pipe & Supply Co.**, San Diego, have been named selected stocking distributors.

---

A heat flow testing device, which utilizes electric heat bulbs and which was developed for demonstrating the relative effectiveness of various insulating materials, may be borrowed for two weeks from **Infra Insulation, Inc.**, 10 Murray St., New York City. The offer is made to builders, engineers, physicists, insulation contractors, building supply houses, teachers, etc. Simple instructions and suggestions are furnished.

"MORE THAN PAID FOR ITSELF ON FIRST JOB"
says Frank M. Kriwanek, General Manager, La Brea Heating and Air Conditioning Co., Los Angeles, Calif.

Aluminum Alloy
UP-RIGHT SCAFFOLDS



Saves scores of man-hours on all installation and maintenance jobs. Requires one man only a minute per section to erect. Available in desired number of 6 foot or shorter section units. Rolled easily from position to position. Stronger than structural steel yet one third the weight. No wrenches, wing nuts, bolts. Each section folds flat.

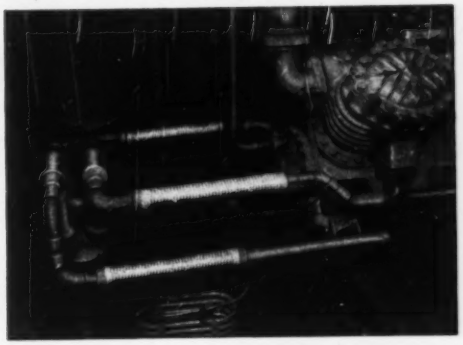
*Write for Descriptive Circular*

**UP-RIGHT SCAFFOLDS**
DEPT. 128 1013 PARDEE STREET
BERKELEY, CALIFORNIA

Factories: Berkeley, Calif. and Teterboro, N. J. • *Sales Offices in All Principal Cities*

*Another Problem* SOLVED

ELIMINATING COMPRESSOR VIBRATION
with **Bendix**
*Eclipse Flexible Metal Hose*



Twenty-four-hour operation of a huge icebox for cold testing (to −83° F.) aircraft instruments, plays a vital role in maintaining the supply line to today's multi-engined and supersonic aircraft. Greater assurance of a continuous duty refrigerating plant was given with the installation of Bendix Vibration Reducers for absorbing compressor vibration. Manufactured from seamless drawn tubing, the deep parallel corrugations and uniform wall thickness assure maximum flexibility and service life. Bendix Vibration Reducers in standard sizes—all chemically cleaned and sealed—are available from stock. Special assemblies can be engineered to your requirements. Write today and let our engineers work out your problem with you.

LOOK FOR THE MARK OF QUALITY

ECLIPSE-PIONEER DIVISION
BENDIX AVIATION CORPORATION
TETERBORO, NEW JERSEY

Bendix AVIATION CORPORATION

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hot water in a hurry!

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AGENTS IN PRINCIPAL CITIES


# NEW BOOKS & REPORTS

## More Data on Weather Required for Heating and Air Conditioning Design

While a lack of completely satisfactory climatic data has not prevented the design, installation, and use of heating and air conditioning systems, performance and economy might be improved by the combined application of better weather data and more scientific treatment of the heat flow and air change calculations connected with estimating heating and cooling loads.

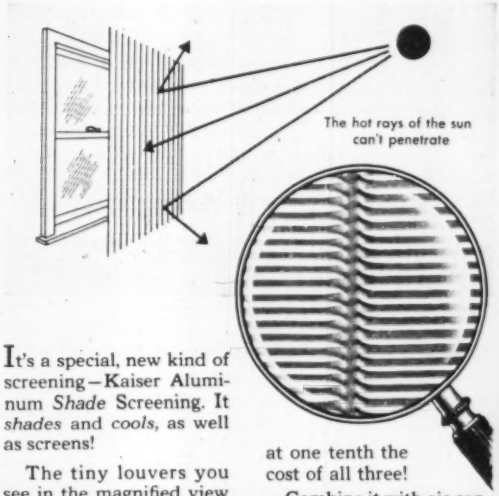
This is a conclusion of C. M. Humphreys, senior engineer, G. V. Parmelee, research associate, and Cyril Tasker, director of research, all of the American Society of Heating and Ventilating engineers, as expressed in their paper, The Role of Weather Data in Heating and Air Conditioning, which was presented at a recent conference sponsored by the Building Research Advisory Board of the National Research Council.

The authors stress the fact that the job of the heating and air conditioning industry is to provide indoor environmental conditions that are comfortable, regardless of conditions which prevail outside, and the degree to which this goal can be achieved is largely dependent on knowledge of the type of weather likely to be encountered. After summarizing the weather factors which influence design, it is pointed out that there is a growing feeling that lack of adequate data often results in designs of systems based on unnecessarily extreme outside temperatures. This results in an oversized system which is relatively expensive to install, difficult to control, and inefficient in operation. More data on the coincidence of outside dry and wet bulb temperatures, wind velocity and direction, and solar radiation intensity are said to be important prerequisites for accurate design. Equally important is the effect of heat storage in most structures.

At the same conference and in his paper, The Role of Climatology in Air Conditioning Design, John Everetts, Jr., of the office of Charles S. Leopold, consulting engineer, compares different types of structures in different climates to demonstrate the importance of weather data in air conditioning design. The three typical structures considered are a residence, an office building, and a theater. The cities chosen for comparison are Chicago, St. Louis, and New Orleans. After briefly describing the data and method used for determining cooling loads, Mr. Everetts analyzes the cooling load in the office building. In Chicago, the load produced by the weather is shown to be 52.6 percent of the total load, of which 40.7 percent is due to ventilation, 5.8 percent to transmission, and 6.1 percent to solar radiation. In New Orleans, 51 percent out of 59.2 percent of weather load is due to ventilation. St. Louis has a total load due to weather of 56.4 percent, of which 44.5 percent is for ventilation and 11.9 percent for transmission and solar radiation. Over 40 percent of the total load in all three cases is caused by lights and people.

Similar analyses are presented for the residence and the theater, and it is shown that in terms of percent of total load, the effects of solar radiation, ventilation, and transmission are widely different for different localities and types of structures. For example, the cooling load

# How screening can help you sell more air conditioning

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*(For both residential and commercial applications)*

Window exposure — West
Midsummer peak load, 40° N. latitude — 3:00 PM

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|---|---|
| Sun load through 100 Sq. Ft. of unshaded windows | 17,000 |
| Sun load through 100 Sq. Ft. of Shade Screening | 1,700 |
| Heat load reduced by | 15,300 |

or 1.28 tons of refrigeration per 100 Sq. Ft. of glass

Hurry—before your competition beats you to it! Start making more sales by combining your air conditioning installations with Kaiser Aluminum Shade Screening.

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chargeable to weather in the case of the residence is over 93 percent of the total with only a variation of 1.1 percent for the three cities.

In conclusion, the author presents a table of relative load factors for summer months and for the three types of structures in the three cities analyzed. Unfortunately, detailed weather data are not available for spring, fall, and winter, so comparisons cannot be made for these seasons. Since these data are necessary for determining operating hours and costs, forecasting public utility loads, and the basic designs of systems, he believes the correlation of weather data should be given high priority.

These two papers are contained in the proceedings of the conference which is published in paper covered book form (8½ x 11 in.) and is available for $3.50 from NRC headquarters, 2101 Constitution Ave., Washington 25, D.C.

### Prevention the Key to Plant Maintenance

Industry is wasting money in its maintenance operations, a few individual plants spending as high as 25 cents of every sales dollar. In its true and most profitable sense, maintenance is not limited to repair, for it is in the realm of preventing breakdown with consequent interruption of production that the greatest savings in costs can be made. This was the general theme of the recent First Plant Maintenance Conference sponsored by the American Society of Mechanical Engineers and the Society for the Advancement of Management.

Papers presented at the meeting covered numerous phases of maintenance and some of the subjects discussed were maintenance organization and management, maintenance costs, budgeting the operation, upkeep of motors, controls, distribution and lighting equipment, lubrication, and the use of electrical instruments.

Two paper covered booklets, entitled Techniques of Plant Maintenance, include the proceedings of this conference. Part 1 is devoted to the texts of prepared papers and addresses and the second booklet includes 554 questions submitted from the floor and the answers. Both are available from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, for $2.00.

### Mean Radiant, Air Temperatures Affect Impressions of Freshness

The effects of radiation from the surroundings on the impressions of freshness of 106 men and 39 women members of the staff of the British Building Research Station were investigated during the first six months of 1948. Subjects were exposed to three types of environment: (1) where the walls were cooler than the air, (2) where the walls and air were at the same temperature, and (3) where the walls were warmer than the air. The tests were carried out in calm air, and subjects were asked to assess their sensations of warmth and impressions of freshness.

A report of the investigation is contained in a paper, The Effect of Radiation from the Surroundings on Subjective Impressions of Freshness, by A. F. Munro and F. A. Chrenko, published in the Vol. 47, No. 3 issue of the Journal of Hygiene.

It was found that the difference between the mean radiant temperature and the air temperature affected freshness impressions, but the effect was relatively slight.

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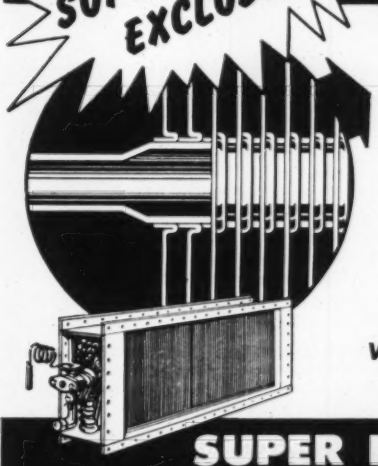

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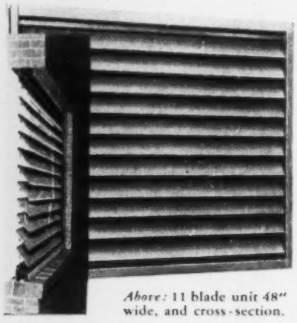
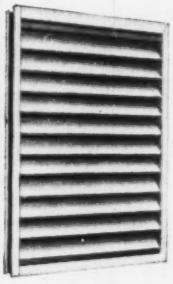


*Above:* 11 blade unit 48" wide, and cross-section.

*Below:* Airlouver unit 30" wide.



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Environments which felt cool tended to feel fresh, yet a rise in the mean radiant temperature—which would increase the warmth of the environment—tended to produce an impression of greater freshness. At a given equivalent temperature, environments with the surroundings warmer than the air were found to be definitely fresher than cold and neutral-wall environments. Changes in humidity insufficient to affect sensations of warmth were found to affect impressions of freshness. Under the conditions of these experiments, and to keep freshness impressions constant, the authors found that a rise of 1 deg in the temperature of calm air must be compensated by a fall of about 5 percent in the relative humidity.

The subjects had a distinct preference for the warm-wall environment; 73 percent of them found it pleasanter than either the cold or the neutral-wall environment.

The paper is a report of the medical research council's group for research in industrial physiology, London School of Hygiene and Tropical Medicine, Keppel and Gower Sts., London, W. C. 1, England.

### Over 300 Technical Documents Listed

Some 313 technical documents, most of them available to the American public for the first time, are listed in the current issue of the Bibliography of Technical Reports. The documents, all accompanied by abstracts or subject catalog descriptions, are derived principally from federal or federally sponsored research. Technical reports are included from a number of foreign countries and some of the subjects deal with chemicals, electronics, fuels, instruments, machinery, medical research, metals and minerals, physics, and rubber. One report covers a high temperature laboratory kiln, another is devoted to a precision pH control, and one provides data on thermal effects of flat concrete roofs.

A limited number of free copies of the bibliography are available from the Office of Technical Services of the U. S. Department of Commerce, Washington 25, D. C.

### Indexes 1700 Nomograms

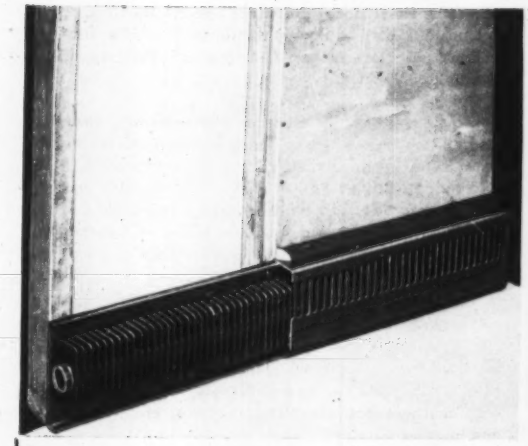
An Index of Nomograms, compiled and edited by Douglas P. Adams, associate professor of graphics, Massachusetts Institute of Technology, lists over 1700 published nomograms in wellknown periodicals.

Published as a time saver for the repeated solution of mathematical formulas, the book directs the reader to the proper nomogram for a specific problem. It is divided into two main parts; a listing of key words associated with each of the diagrams and a master index listing the periodical, date of issue, volume number, and page number. The author also gives the variables employed in each diagram. Abbreviations of all periodicals and variables used in the index are listed.

The book is clothbound, contains 174 pages, and is priced at $4.00. Copies may be obtained from John Wiley & Sons, Inc., 440 Fourth Ave., New York 16.

### Other Books and Reports Received

**Simplified Practice Recommendation R238-50, Convectors**—The recommendation is basically a simplified listing of sizes and types of convectors used. Both units with nonferrous and cast iron heating sections are included, and the various types are defined and illustrated by outline drawings. The new simplified list represents a substantial reduction in the number of combinations.



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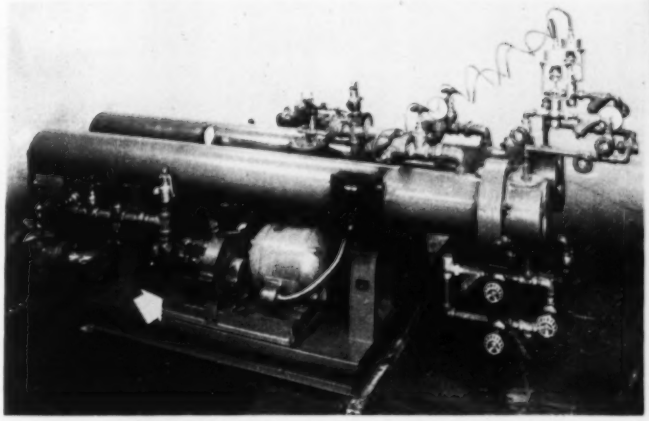

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Printed copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. for 5 cents each.

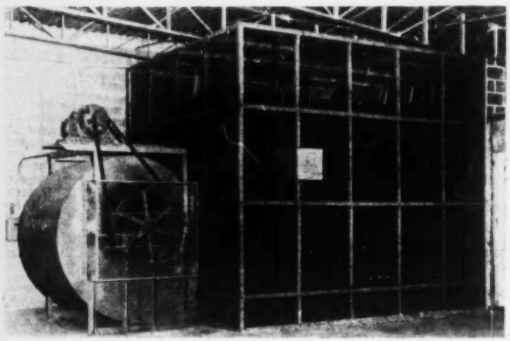
**Commercial Standard CS5-46, Pipe Nipples**—An addenda sheet for the commercial standard entitled Pipe Nipples; Brass, Copper, Steel and Wrought Iron is available without charge from the Commodity Standards Division, National Bureau of Standards, Washington 25, D. C. Printed copies of the standard with the addenda inserted are for sale by the Superintendent of Documents, Government Printing Office, Washington 25, D. C. for 5 cents each. The standard covers pipe nipples made from new, full weight, mill tested pipe conforming to recognized standard specifications. The manner in which the ends of nipples are cut and threaded is specified, and standard sizes and lengths are given, together with lists of standard assortments of sizes and lengths. This is enlarged by the addenda to give the standard number of nipples in packages containing but one size and length. Information to be shown on labels or tags for standard packages is also given.

**Simplified Practice Recommendation R157-50, Steel Firebox Boilers and Steel Heating Boilers**—This booklet supersedes a similar recommendation, R157-37. Defined in the new publication are such terms as rating, net rating, and heating surface. It lists the data to be shown on commercial steel boilers as well as on residential steel boilers. The section on commercial boilers has been revised, and its provisions are now similar to those of the SBI rating code. Copies are available for 10 cents from either the Steel Boiler Institute, Land Title Bldg., Broad & Chestnut Sts., Philadelphia 10, or from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

**The Computation of Heat Requirements for Buildings**, 1950 edition, published by the Institution of Heating and Ventilating Engineers, 75 Eaton Place, London, S.W.1, England, priced at 3s. 0d. Net. This booklet was first published in 1942. In the new edition a number of sections have been revised, and the tables of thermal conductivity and resistivity have been revised and extended to include new materials.

**Handbook of Conversion Factors**, by Marvin H. Green, available from Educational Publishers, Inc., 122 N. 7th St., St. Louis 1, for $1.50. The booklet contains 88 pages (4½ x 7 in.) and contains 2500 conversion factors dealing with mathematics, chemistry, physics, architecture, and engineering.

**National Fire Codes, Vol. II, Prevention of Dust Explosions**—The 1950 edition is priced at $3.00 and is offered by the National Fire Protection Association, 60 Batterymarch St., Boston 10. New and revised codes adopted by the National Fire Protection Association at its 1947, 1948, and 1949 annual meetings are incorporated and changes from the previous 1946 edition include an extensive revision of fundamental principles for the prevention of dust explosions in industrial plants. The record of dust explosions in the Appendix has been enlarged and rearranged.

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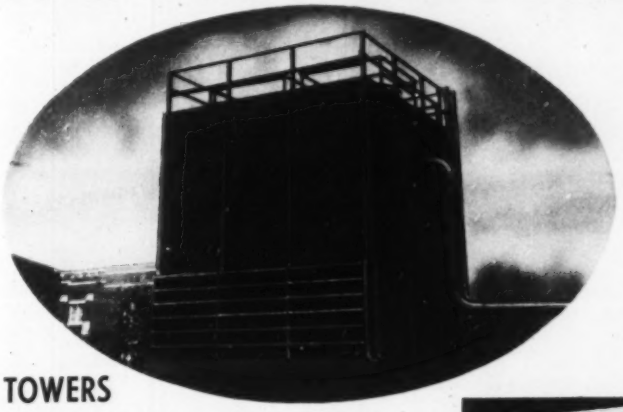

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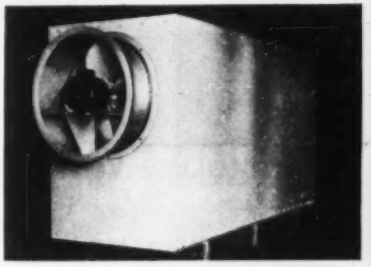

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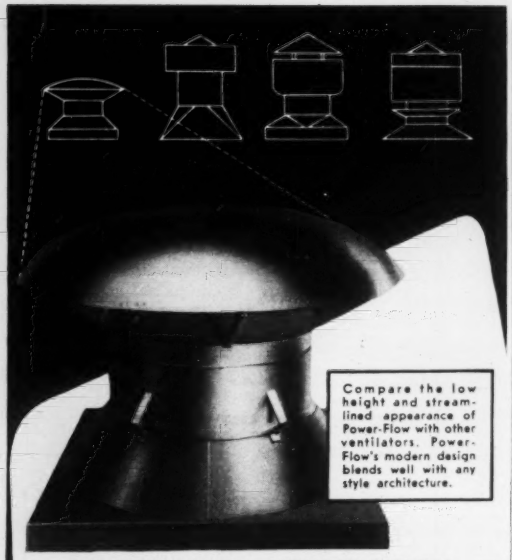
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# MEETINGS & CONVENTIONS

**Smoke Prevention Association of America,** 1950 annual conference, May 21 to 25, Mount Royal hotel, Montreal, Canada—A number of technical societies will sponsor the various sessions. Reservations for hotel accommodations should be sent to R. Grossman, secretary-treasurer, convention committee, Room 203, 1405 Bishop St., Montreal, Canada.

**National District Heating Association,** 827 N. Euclid Ave., Pittsburgh 6—The 41st annual meeting, Grove Park Inn, Asheville, N. C., May 23 to 26.

The Hotel Statler, Detroit, has been selected for the Society's 1951 annual meeting.

**Refrigeration and Air Conditioning Conference and Exhibit,** sponsored jointly by the Refrigeration Equipment Manufacturers Association and the Refrigeration Service Engineers Society—The first in a series of four will be held May 25 to 28, Hotel Jefferson, St. Louis. Schedules for the others are: November 17 to 19, Municipal Auditorium, Long Beach, Calif.; January 26 to 28, State Fair Grounds, Dallas; April 6 to 8, Hotel Statler, Buffalo.

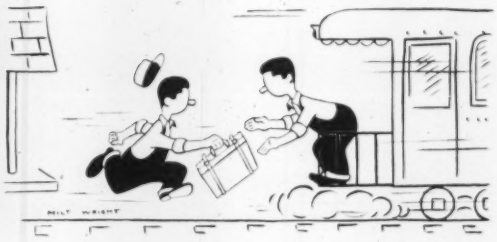
Additional information may be obtained from the REMA public relations department, 1346 Connecticut Ave., N.W., Washington 6, D. C.

**Canadian International Trade Fair**—To be held May 29 to June 9, Exhibition Grounds, Toronto, Canada.

**American Society of Refrigerating Engineers,** 40 W. 40th St., New York 18—The 37th spring meeting, June 4 to 7, Muehlebach hotel, Kansas City, Mo. Nine papers, grouped into one session of technical papers and two sessions of application type papers are scheduled.

**I-B-R Heating Short Course,** sponsored by the Institute of Boiler and Radiator Manufacturers and the University of Illinois—The fourth short course on steam and hot water heating will be held June 13 to 16, at the University. There will be a program for new students and also one for former students who desire more advanced work.

Requests for information on the course should be addressed to R. K. Newton, supervisor, engineering extension, division of university extension, Room 305, Arcade Bldg., University of Illinois, Urbana, Ill.



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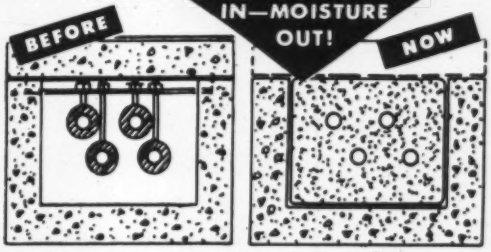


Open void permits water to attack insulation and increases the chance of heat loss due to convection.

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Heads to 105 feet.

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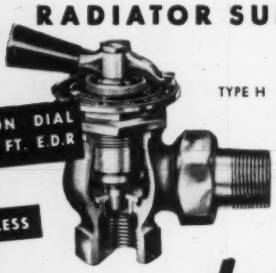


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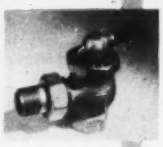

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**Stoker Manufacturers Association,** 307 N. Michigan Ave., Chicago 1—The 1950 annual meeting, to be held June 15, La Salle hotel, Chicago.

**Industrial Hygiene and Human Relations**—A training course designed especially for the benefit of safety personnel to be held June 19 to 21, University of Michigan School of Public Health, Ann Arbor, Mich. Among the papers scheduled for presentation is one on process ventilation and maintenance, by Allen D. Brandt, industrial hygiene engineer, Bethlehem Steel Co. In a session on industrial health problems in connection with plating, pickling, spraying, sand blasting, and heat treatment, medical aspects will be discussed by T. I. Boileau, M.D., of the Murray Corp. of America, and daily recognition of problems will be covered by John Radcliffe, industrial hygienist, medical dept., Ford Motor Co. Metals and dusts will be described by William G. Frederick, director, Bureau of Industrial Hygiene, Detroit Department of Health, and a paper by William P. Yant, research director, Mine Safety Appliances Co., will deal with gases.

Applications for enrollment should be submitted to H. E. Miller at the School of Public Health. The fee is $5.00.

**American Society of Mechanical Engineers,** 29 W. 39th St., New York City—The semi-annual meeting will be held June 19 to 23, Hotel Statler, St. Louis. The fall meeting is scheduled for September 19 to 21, Hotel Sheraton, Worcester, Mass., and the annual meeting will be held November 26 to December 1, Hotel Statler, New York City.

**American Society of Heating and Ventilating Engineers,** 51 Madison Ave., New York 10. Semi-annual meeting, Royal Muskoka hotel, on the Muskoka lakes, Ontario, Canada, June 19 to 21. For details, see the ASHVE Journal Section in this issue.

The 1951 annual meeting will be held in Philadelphia, January 22 to 25.

**American Society for Testing Materials,** 1916 Race St., Philadelphia 3—The 1950 annual meeting and 9th Exhibit of Testing Apparatus and Equipment, June 26 to 30, Atlantic City. The 1951 annual meeting is scheduled for June 18 to 21, Atlantic City, and the 1952 annual meeting will be held June 22 to 27, New York City.

**First United States International Trade Fair**—To be held August 7 to 20, Chicago. Exhibits will be classified under 29 categories, including both industrial and consumer commodities, and will include displays of heating, ventilating, and air conditioning equipment. Fair headquarters is in the Merchandise Mart, Chicago 54.

**Sixth National Chemical Exposition,** sponsored by the Chicago section of the American Chemical Society, 86 E. Randolph St., Chicago 1—To be held September 5 to 9, Chicago Coliseum. The show will be held concurrently with the national meeting of the American Chemical Society.

**Refrigeration Service Engineers Society,** 433 N. Waller Ave., Chicago—The 13th annual meeting, November 17 through 19, Long Beach, Calif.

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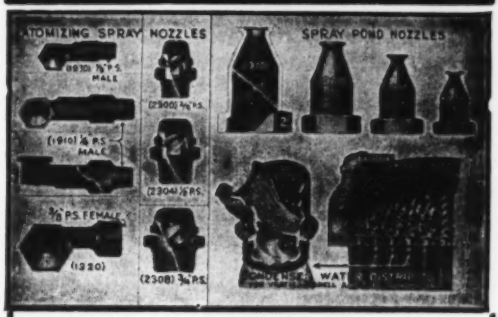


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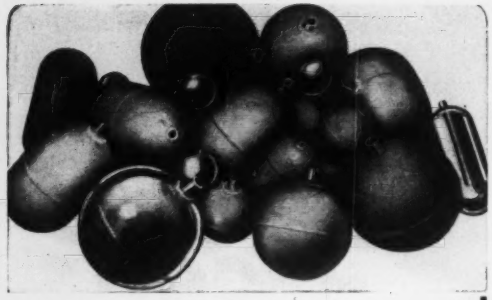

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# RECENT TRADE LITERATURE

*For your convenience in obtaining copies of these bulletins, see coupon on page 193. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.*

**HPAC 7634—ACETYLENE TORCH**—A new folder on the "Century" automatic acetylene gun describes its operation, advantages, and applications. Olsen Tool & Die Corp., 25-11 38th Ave., Long Island City, N. Y. is the sole distributor of this unit which has a pistol grip and is recommended for use in soldering, light brazing, etc.

**HPAC 7635—ACTUATING CYLINDERS**—Both pneumatic and hydraulic types are described and illustrated in a 12 page bulletin (No. 500) issued by Ledeen Mfg. Co., 1600 S. San Pedro St., Los Angeles 15. Dimensions, weights, ratings, and limitations of the medium duty line, heavy duty line, and "super" duty line are given.

**HPAC 7636—AIR RECOVERY CELLS**—Bulletin 117-C of W. B. Connor Engineering Corp., 114 E. 32nd St., New York 16, covers the recently introduced type C air recovery or purification cells for reclaiming odorous conditioned air. Each cell contains approximately 35 lb of granular activated carbon and is designed to adsorb and retain about 7 lb of gaseous and vaporous impurities. Advantages, applications, and construction features of the cells are described.

**HPAC 7637—BASEBOARD RADIATION**—The "Baseline" unit of Baseline Mfg. Corp., 2137 K St., N.W., Washington 7, D.C., consists of a cap and back assembly, a damper, support brackets, a front cover, core brackets, front cover splicers, and a finned heating core of either the single or double type. Advantages and features are described in a new four page bulletin.

**HPAC 7638—BLOW TORCHES, FIRE POTS**—Turner Brass Works, Sycamore, Ill., has issued a new folder on its redesigned blow torches. Also described and illustrated are low pressure firepots.

**HPAC 7639—BOILER TUBES**—Bulletin TB-331 of Babcock & Wilcox Tube Co., Beaver Falls, Pa., provides data on electric-resistance welded-steel boiler tubes. Information on maximum allowable working pressures and weights per lineal foot of tube is tabulated.

**HPAC 7640—CHEMICAL MOTORS**—A four page booklet (B-4687), describing "Life-Line" chemical motors for operation in atmospheres where corrosive fumes and liquids are encountered, is available from Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30. Internal construction features and the treatment of external parts for corrosion resistance are described. Also included are the results of salt spray corrosion tests.

**HPAC 7641—CONTROL OF HUMIDITY**—The method of Niagara Blower Co., 405 Lexington Ave., New York 17, utilizes "Hygrol," a hygroscopic liquid, for absorbing moisture directly from the air. A new engineering data

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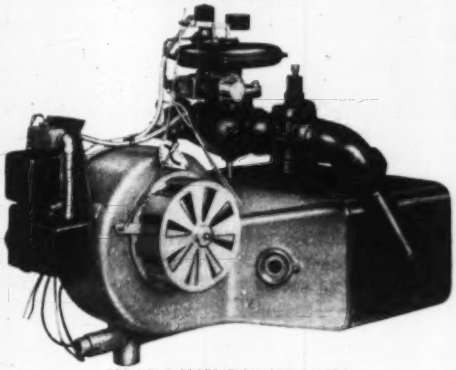

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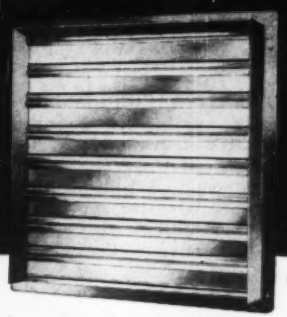

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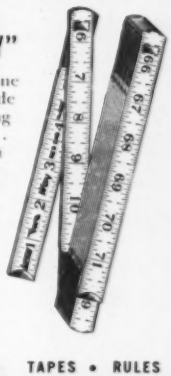

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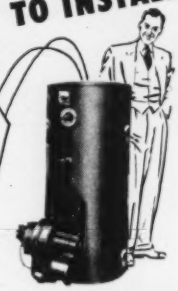

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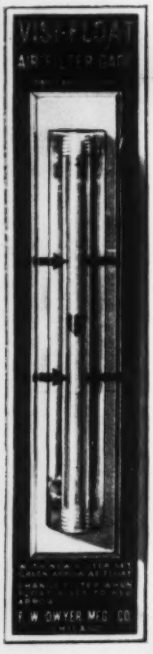


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**HPAC 7642—COOLING TOWERS**—Bulletin AQ-50 of Marley Co., Inc., Kansas City 15, Kans., gives specifications, dimensions, and capacities of the new "Aquatower" water cooling towers of the mechanical draft type. Capacities of the eight models range from approximately 3 to 60 tons.

**HPAC 7643—DEHUMIDIFYING MACHINES**—Daly, Merritt & Sullivan, Inc., 935 Hughes Ct., N.W., Washington 7, D.C., has issued a folder and a specification sheet on 3 models of "Desomatic" dynamic dehumidifying machines. These adsorption units were developed after research primarily in connection with the preservation of materials for the U. S. Navy.

**HPAC 7644—DUST CONTROL WITH WETTING AGENT**—"Aquadyne" is a multiphase wetting compound formulated to reduce the interfacial tension of ordinary water and to increase the wettability of all types of dust and powdery materials. A four page folder devoted to foundry dust control and sand conditioning has been issue by Aquadyne Corp., 220 E. 42nd St., New York 17. Applications in connection with shakeout machines, conveyors, core knockout, and both wet and dry type dust collectors are discussed.

**HPAC 7645—ELECTRIC INSTRUMENTS**—A revised 150 page manual (GET-1087A) published by General Electric Co., Schenectady 5, N. Y. and available for $1.00. It describes the fundamentals of construction and operating principles of all major types of electric instruments, including thermocouples, synchroscopes, frequency meters, and electric telemeters.

**HPAC 7646—EVAPORATIVE CONDENSERS**—For ammonia and "Freon-12" systems are described and illustrated in Bulletin 234-E of Frick Co., Waynesboro, Pa. Principles of operation, coil design, fans, pumps, and housings, together with unit and built-up types are discussed. Dimensions are tabulated for these units offered in sizes from 3 to 138 tons. Another new bulletin (No. 196-G) illustrates various applications of the company's air conditioning, refrigerating, and ice making equipment.

**HPAC 7647—EXHAUST FANS**—Both direct drive and belt driven models of the propeller type are covered in a 16 page bulletin (X6559) of Emerson Electric Mfg. Co., St. Louis 21, Mo. Dimensions, performance data, and specifications are given and three pages are devoted to the determination of proper sizes.

**HPAC 7648—FUEL OIL HEATER**—Yula Water Heaters, Inc., 166 W. 225th St., New York City, has issued an eight page catalog on its "Thermosyphon" fuel oil heater equipped with an expansion tank and designed to preheat No. 6 fuel oil. The unit is designed for use as a "below water-line heater" in oil fired installations where

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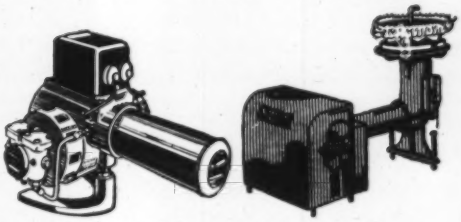

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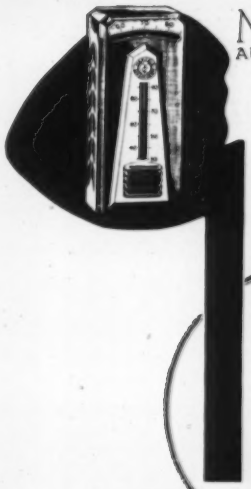

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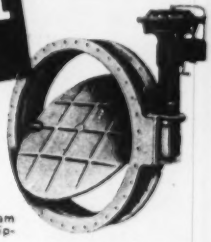

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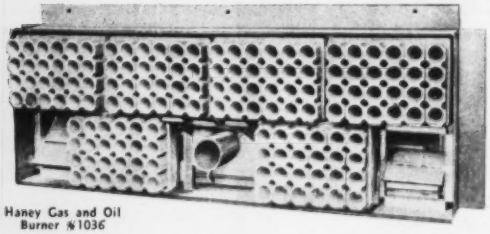

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The HANEY 1000 SERIES BURNERS arranged in many shapes and sizes are complete with windbox, full size gas manifold, automatic vane type air louvre and linkage, tailor-made for your installation giving long life, free from trouble.

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- Motor out of the air stream.
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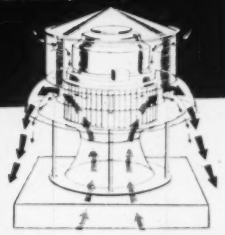

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Omaha, Nebr. Owatonna, Minn.


there is no need for maintaining the boiler at steaming conditions throughout the year.

**HPAC 7649—FUEL OIL TREATMENT**—Power Chemicals Div., E. F. Drew & Co., Inc., 15 E. 26th St., New York 10, has released a technical folder on fuel oil treatment and sludge removal. The folder describes the company's "Ameroid" treatment for preventing or correcting unsatisfactory conditions in the storing, handling, pumping, heating, and burning of industrial fuel oil.

**HPAC 7650—HEAT TRANSFER UNITS**—The "Paracoil" converters of Davis Engineering Corp., 1064 E. Grand St., Elizabeth 4, N. J., are heat transfer units designed to supply hot water for heating and process systems. Bulletin 70 provides dimensional data and capacity ratings for 88 standard sizes. Capacities are expressed for various steam pressures from 0 to 25 psi and for nine temperature ranges. The bulletin also includes the pressure drop for each unit at its rated capacity and provides data for determining the pressure loss through each unit when operating at less than rated capacity.

**HPAC 7651—INDUSTRIAL CONTROL DEVICES**—For temperature, flow, pressure, liquid level, and humidity. Catalog 8303 of Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne and Windrim Aves., Philadelphia 44, presents over 100 different models of non-indicating electric, electronic, and pneumatic controllers recommended for numerous industrial applications. Additions to the previous line, which are shown for the first time, include electronic temperature controllers, self contained electric temperature controllers, and pneumatic insertion type temperature controllers.

**HPAC 7652—INDUSTRIAL TAPE**—Tape is a Tool is the title of a new pocket size catalog issued by Bauer & Black, Div. of Kendall Co., 222 W. Adams St., Chicago 6. Dozens of "Polyken" industrial tapes are listed, along with specifications and applications. Sample strips of many tapes are reproduced with magnified sections showing construction details.

**HPAC 7653—INERT GAS-SHIELDED ARC WELDING**—Features and specifications of "Heliarc" apparatus available from Linde Air Products Co., 30 E. 42nd St., New York 17, are given in a new folder, F-7013. Equipment illustrated includes five models of the torch for manual or mechanized operation, a new argon regulator and argon flowmeter, ceramic and water cooled shielding-gas cups, electrodes, and the argon-water shutoff valve. Advantages of this welding process and the metals for which it can be used are described.

**HPAC 7654—MECHANICAL DRAFT FANS**—Both double and single width induced draft fans, forced draft fans, combination draft fans, and primary air fans are covered in Bulletin 3750 of Buffalo Forge Co., P. O. Box 985, Buffalo, N. Y. Design and construction features and types of drives are discussed and typical performance curves are included.

**HPAC 7655—PACKAGED STEAM GENERATOR**—The Vol. 25, No. 3 issue of the house organ published by Foster Wheeler Corp., 165 Broadway, New York 16,

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Our new *Unitbilt* Boiler-Stoker Combinations are fully described and illustrated in Bulletin No. SF-1. It contains complete engineering and dimensional data. A copy will be gladly sent upon request. Clip this advertisement or make a memorandum to write us.

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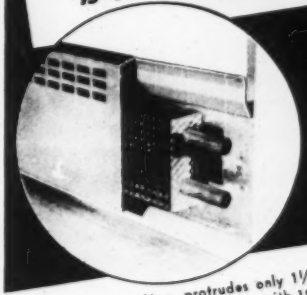

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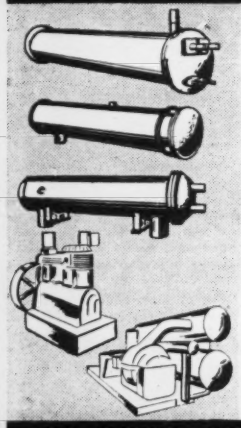

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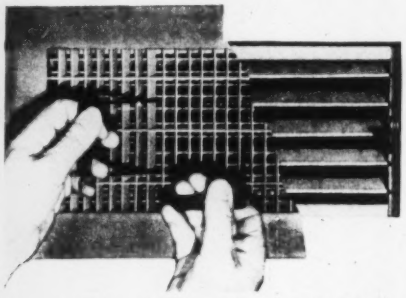

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covers design and construction features of the firm's water tube, packaged steam generators which are designed for coal, gas, or oil firing. Dimensions and performance curves are given for units, offered in various sizes, having capacities from 1500 to 35,000 lb per hr of steam and for pressures up to 900 psi. The booklet also illustrates installations of other company products, such as marine steam generators and cooling towers.

**HPAC 7656—PANEL HEATING CONTROLS**—The 13th issue of Engineering News, prepared by Hoffman Specialty Co., 1001 York St., Indianapolis 7, covers the application of the firm's 900 series "Panelmatic" hot water heating control system. Basic models and variations are described and sample specifications are included. Of the remaining 12 bulletins, also offered by the company, seven deal with various aspects of panel heating and others cover air vents, float and thermostatic traps, radiator vent valves, etc.

**HPAC 7657—PLANT-WIDE FLOW METERING**—The "Ratosleeve" flow meter is a variable-area instrument for plant-wide service. It is designed to measure flow rates from 4.5 to 6200 gpm of liquid, 12.5 to 12,500 cfm of gas, and up to 114,000 lb per hr of steam at 125 psi. Basic metering parts, indicators, controllers, recorders, integrators, and telemetering instruments are covered in Catalog 83 of Fischer & Porter Co., Hatboro, Pa.

**HPAC 7658—PUMPS**—Penberthy Injector Co., 1242 Holden Ave., Detroit 2, has released Bulletin 5030 on its cycling jet pump operated by air, gas, or steam pressure. Said to be nonclogging and self priming, it is recommended for virtually any liquid and will discharge approximately 1380 gph against a 30 psi discharge pressure. A new data sheet on the company's explosionproof and totally enclosed, automatic electric sump pumps provides information on design, materials of construction, etc.

**HPAC 7659—PUMPS**—Mixed flow volute type pumps are the subject of a new catalog (No. F-1049) issued by Economy Pumps, Inc., Hamilton, Ohio. Catalog No. E-748 provides detailed information on the company's types VSL and VS general service sump pumps. Nonclogging centrifugal pumps with capacities from 50 to 20,000 gpm are described and illustrated in another new catalog (No. F-249).

**HPAC 7660—PUMPS, CONDENSATE RETURN UNITS**—A 53 page catalog (Bulletin B-588) issued by Peerless Pump Div., Food Machinery and Chemical Corp., 2005 Northwestern Ave., Indianapolis, Ind. Gives detailed information on condensate return units having capacities from 1000 to 100,000 EDR and various pumps including positive displacement, turbine, "Fluidyne" centrifugal, and reciprocating types. Also covered are both deep and shallow well water systems.

**HPAC 7661—RADIATOR VALVES, TRAPS**—Sections 10 and 11 of the catalog of Marsh Heating Equipment Co., Skokie, Ill., provide detailed information on the firm's line of radiator valves and traps. Available patterns, dimensions, and other pertinent information are given on three series of packless valves and low, medium, and high pressure thermostatic traps.

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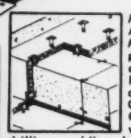

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**HPAC 7662—REFRIGERATION EQUIPMENT**—Catalog No. 350 of Bush Mfg. Co., West Hartford 10, Conn., includes dimensions, capacities, specifications, and descriptive material on evaporative condensers from 5 to 75 tons in size and cooling towers from 3 to 75 tons in size. Detailed information is also given on commercial refrigeration equipment such as unit coolers, ice makers, finned coils, bare tube coils, replacement condensers, etc.

**HPAC 7663—ROOF COOLING**—The advantages of spraying water on roofs to assist mechanical and evaporative cooling systems, ventilation systems, and in conjunction with night air cooling are discussed in an article by Siegfried Ruppright, consulting engineer. The article also gives information on a moving nozzle spray method. Reprint copies are available from Ruppright's Rotary Roof Cooler, P. O. Box 6795, Los Angeles 22.

**HPAC 7664—ROOF VENTILATOR**—A new folder prepared by Iron Lung Ventilator Co., 4019 Prospect Ave., Cleveland 3, illustrates and describes a number of foundry installations of its fan type roof ventilator. Design and construction features are outlined.

**HPAC 7665—SAFETY HEADS, ACCESSORIES**—A 16 page catalog and price list on safety head flanges, rupture discs, and vacuum supports, together with refrigerant relief valves, pressure-vacuum vent valves, and combined vent valve-flame arrestor units has been issued by Black Sivalls & Bryson, Inc., 720 Delaware, Kansas City 6, Mo. Also included are examples on how to order the various sizes of safety heads and accessories.

**HPAC 7666—SWIVEL PIPE COUPLINGS**—Eight basic styles of "All-Flex" ball bearing type units are available in sizes from ⅜ to 12 in. and for pressures from vacuum to 12,000 psi from Gil-Lair Products, Inc., 81 Masonic Ct., Pasadena, Calif. Specifications, working pressures, and prices are given in Catalog 50, which also covers various types of hose.

**HPAC 7667—SYNCHRONOUS MOTORS**—Publication GEA-5332 of General Electric Co., Schenectady 5, N. Y., covers low speed, synchronous motors. Typical installations, construction features, mechanical modifications, and performance data are given for these 6000 series motors rated from 20 to 15,000 hp.

**HPAC 7668—VIBRATION CONTROL**—Bulletin G-102 of Korfund Co., Inc., 48-01-F 32nd Pl., Long Island City 1, N. Y., gives characteristics of various types of vibration isolation media—springs, rubber, and cork materials. Some 50 typical machine and equipment applications are tabulated with recommended types of isolators for highest efficiency and also alternates for less exacting requirements. Specific purpose isolators, such as for fan and motor units, are covered.

**HPAC 7669—WATER COOLERS**—Of the direct expansion type and U tube construction are covered in Catalog 401 of Doyle & Roth Mfg. Co., 136-50 24th St., Brooklyn 32, N. Y. Nominal ratings range from 4½ to 156 tons and chiller shells are from 6 to 24 in. in diameter. Specifications, ratings, dimensions, and selection data are included.

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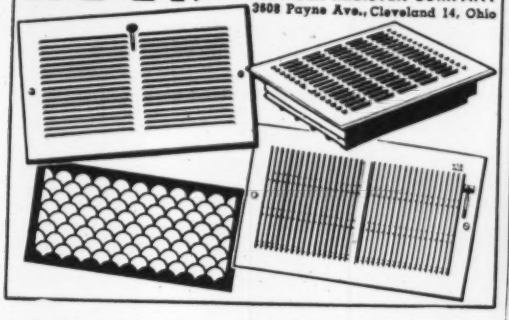

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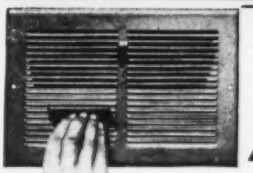

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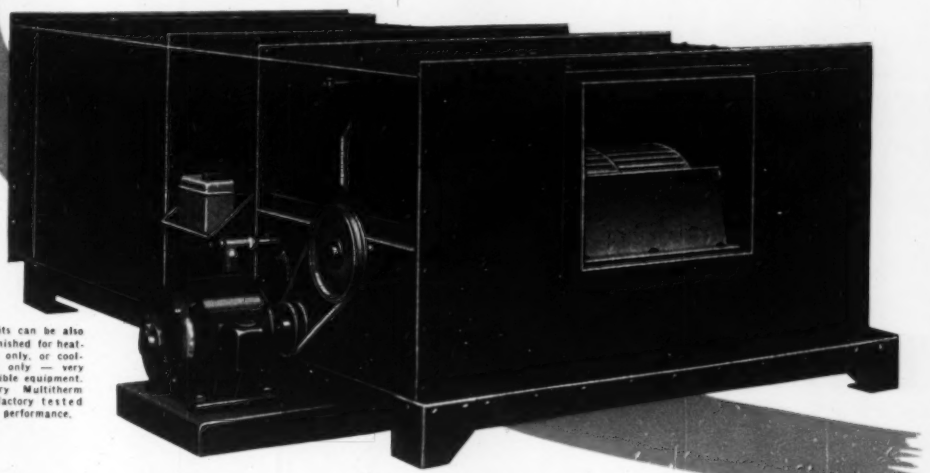
# AIR CONDITION!



*Units can be also furnished for heating only, or cooling only — very flexible equipment. Every Multitherm is factory tested for performance.

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Write us, outlining your requirements — or ask for Bulletin 107 giving complete information.

**SOME OF OUR OTHER PRODUCTS**

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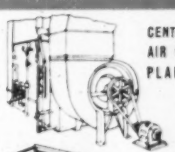

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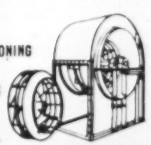

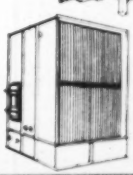

AIR WASHERS

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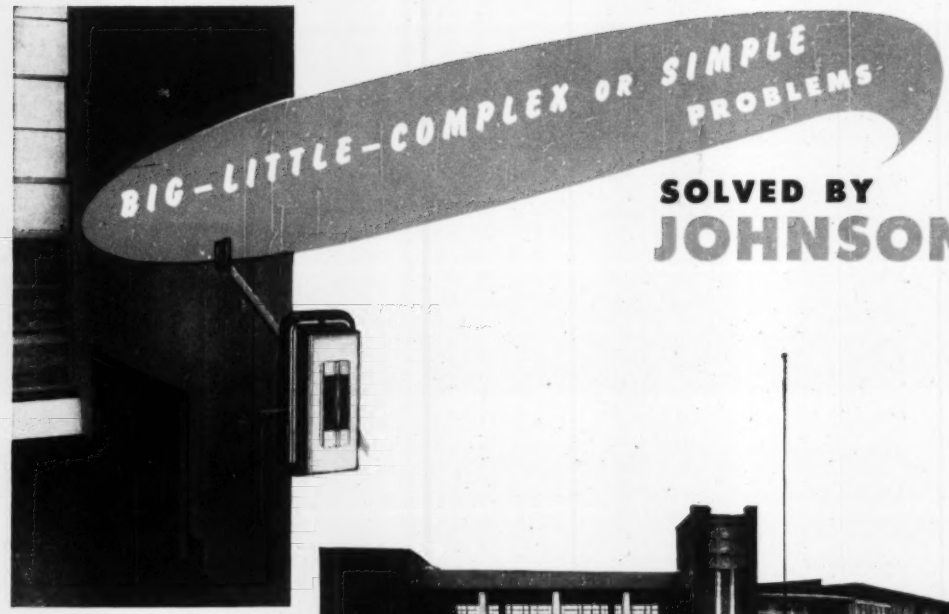


# SOLVED BY JOHNSON

Blackberry Lane School, University City, Mo. William B. Ittner, Inc., architects and engineers; C. J. Moritz Heating Co., heating contractors, both of St. Louis.

T-901 Johnson Sub-master hot water Thermostat.

Year after year, Johnson engineers have been employed to solve temperature control problems—to help put the breath of comfortable living into modern construction. Johnson plans, then manufactures and installs the complete control system. Regardless of the problem, each Johnson installation fits the specific need.

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